



PROJECT MANUAL

**RAMAPO COLLEGE OF NEW JERSEY
COLLEGE COMMONS**

RCNJ PROJECT No. 12-281C

**Issue for Bid
September 28, 2015**

PREPARED BY:

ikon.5 Architects
864 Mapleton Road,
Suite 100
Princeton, NJ 08540
609.919.0099

Thornton Tomasetti
24 Commerce Street
Newark, NJ 07102
973.286.6100

Loring Consulting Engineers
300 Alexander Park Drive
Princeton, NJ 08540
609.716.6160

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RAMAPO COLLEGE OF NEW JERSEY
505 RAMAPO VALLEY ROAD
MAHWAH, NJ 07430
NOTICE TO BIDDERS

PROPOSAL NO. 12-281C

PUBLIC NOTICE is hereby given that SEALED BIDS will be received for the **College Commons Project**.

Sealed bids will be received at the Office of the Director of Purchasing, Academic Complex Wing D Room D-116, Ramapo College of New Jersey, 505 Ramapo Valley Rd., Mahwah, NJ until **2 PM local time, Wednesday, October 28, 2015**, at which time they will be publicly opened. If because of inclement weather the College is officially closed on the bid due date, the bid opening will be postponed until the next business day at the originally scheduled time.

The project involves selective interior demolition and renovation of a 2,690 square feet structure to be converted into a common space for students and faculty. Limited site work includes regrading and new concrete and paved walks. The interior will have an open seating area and a serving area for food. The remaining spaces are support for these functions. Bids will be received for a single lump sum contract covering all work indicated in the construction documents.

A **MANDATORY** Pre-Bid Conference and Site Inspection have been scheduled promptly at **10 AM on Thursday, October 8, 2015** at the **Carriage House, formerly the Print Shop** at Ramapo College of New Jersey. If, because of inclement weather, the college is officially closed on the Pre-Bid Conference date, the mandatory pre-bid conference and site inspection will be postponed until the next business day when the college is open at the originally scheduled time and location.

The Bid Documents will be available for download from the College's website: <http://www.ramapo.edu/construction-projects/college-commons/> **Thursday, October 1, 2015, at 12 PM.**

All questions are to be submitted to the attention of **Seamus Doran**, Ramapo College of New Jersey, sdoran@ramapo.edu until **4 PM local time, Friday, October 16, 2015.**

Proposals must be made upon, and in accordance with, the bid forms supplied by the Director of Purchasing. Bid proposals shall hold for sixty (60) days from the date of the bid opening.

Bidders are required to comply with requirements of New Jersey Public Law 1975 Chapter 127 (N.J.S.A. 10:5-31 et seq.) and regulations set forth in (N.J.A.C. 17:27). All contractors bidding on this project shall hold a prequalification trade code of C006, C008, and/or C009 by the New Jersey State Division of Property Management and Construction (NJDPMC) in accordance with the N.J. Statutes (N.J.S.A. 52:35.1 et seq.) and must be insured. All bidders, and their subcontractors, shall be registered with the Commissioner of Labor for Public Works in accordance with New Jersey Public Law 1999 Chapter 238 B, The Public Works Contractor Registration Act. All bidders shall comply with New Jersey Public Law 2005 Chapter 51 (formerly Executive Order 134).

Bids must be accompanied by a Certified or Cashier's check or Bid Bond payable to Ramapo College of New Jersey in the amount of ten percent (10%) of the total amount bid. The bidder shall provide a Certificate of Surety from a company authorized to issue such coverage in the State of New Jersey. The bidder's surety shall state that 100% performance and payment bonds will be furnished to the successful bidder.

A Prevailing Wage Rate Determination will be made a part of the final contract document.

The College reserves the right to waive any informality or to reject any or all bids. Bid envelopes must be marked with **Bid No. 12-281C** and indicate "Sealed Bid" in the lower left hand corner.

Richard M. Roberts
Contracting Officer
(201) 684-7616

I. INSTRUCTIONS TO BIDDERS

IB1 Bid Proposals

IB1.1 Sealed proposals for the work described herein must be received and time-stamped at the College. The closing date and time for bids will be stated in the advertised Notice to Bidders. Bidders are cautioned that reliance on the U.S. Mail for timely delivery of proposals is at the Bidders risk. Failure by the Contractor to have sealed proposals reach the College by the prescribed time will result in a return of the submission unopened and unread.

IB1.2 Bids will be received for General Construction (LUMP SUM) inclusive of all trades as required in the bid documents including, but not limited to:

- (1) Structural Steel and Ornamental Iron Work
- (2) Plumbing and Gas Fitting Work
- (3) Heating and Ventilating Systems and Equipment
- (4) Electrical Work
- (5) All Other Work and Materials Required for the Completion of the Project

IB1.3 The College reserves the right to deny award to any Bidder who is not responsible, based upon experience, past performance, and financial capability to perform the work required hereunder, or other material factors.

IB1.4 Bid proposals based upon the Plans, Specifications, and Addenda, shall be deemed as having been made by the Contractor with full knowledge of the conditions therein. Bidders are required to visit the site prior to submitting proposals for the work herein described, and to have thoroughly examined the conditions under which the Contract is to be executed including those reasonably observable conditions of the premises which would hinder, delay, or otherwise affect the performance of the Contractor required under the terms of the Contract. The College will not allow claims for additional costs as a result of the Contractor's failure to become aware of the reasonably observable conditions affecting the required performance of the Contractor. The bidder is required to make appropriate allowances in the preparation of his Bid for the accommodation of such conditions. By submitting a bid, the Bidder confirms acknowledgement of existing conditions at the site at the time the Bid is submitted.

IB1.5 Bid proposals shall be submitted on the standard form provided by the College, enclosed in a sealed envelope. The name and address of the Bidder must be indicated on the envelope, as well as indication of the College Project Number, project location and other appropriate identification.

IB1.6 All amounts in the Bid Documents shall be stated in both words and numerical figures. In case of discrepancy between the words and numerical figures, the words shall govern.

IB1.7 The Bidder must submit the following documents in the bid envelope:

- (1) Bid Cover Sheet
- (2) Proposal Form
- (3) Non-Collusion Affidavit Form
- (4) Stockholder Discloser Form
- (5) Agreement of Surety
- (6) Bid Security Form
- (7) NJ Public Works Registration Certificate of the Bidder

The Bidder must submit the following documents in the bid envelope from the listed Structural Steel and Ornamental

Iron, Plumbing and Gas Fitting, Heating and Ventilating Systems and Equipment, and Electrical Subcontractors:

- (1) NJ Public Works Registration Certificate
- (2) NJ Licenses of Plumbing and Electrical Subcontractors

IB1.8 Proposals shall remain open for acceptance and may not be withdrawn for a period of sixty (60) days after Bid Opening Date.

IB1.9 Proposals not submitted and filed in accordance with instructions contained herein and in the Notice to Bidders may be rejected as non-responsive.

IB1.10 The Bidder shall make no additional stipulations in the Bid Proposal nor qualify his bid in any manner. Such qualification may result in the bid proposal being considered non-responsive.

1B2 Notice of Intent to Award & Bid Protest Procedures

1B2.1 Within sixty (60) days of a bid opening, the College shall provide to all bidders a copy of a "Notice of Intent to Award a Contract;" and shall notify any nonresponsive/nonresponsible bidder of the basis for disqualification, unless, within the sixty (60) day period, the College requests that bidders agree to permit the bids to be held for a longer time period for consideration pending issuance of a "Notice of Intent to Award."

1B2.2 Any bidder, having submitted a proposal in response to this RFP and finding cause to protest the College's disqualification of a bid, or notice of intent to award, may make written request to the Contracting Officer setting forth, in detail, the specific grounds for challenging the disqualification of its bid or for challenging the College's intent to award the Contract, as applicable. The protest shall be filed within five (5) business days following the bidder's receipt of written notification that its bid is disqualified or of notice of the intent to award, as applicable.

1B2.3 The College shall consider the written record when deciding a bid protest. The written record may include, but is not limited to, the written protest, any written response to the protest submitted by the lowest responsible bidder, the terms, conditions and requirements of the RFP, the proposals submitted in response to the RFP, the evaluation committee report and/or the award recommendation document, pertinent administrative rules, statutes, and case law, and any associated documentation the College deems appropriate. In cases where no in-person presentation is deemed necessary pursuant to Section 1B2.4 below, the College shall afford the protester and other interested parties a fair opportunity to submit written statements and documents supporting the facts and the legal arguments relevant to the bid protest.

1B2.4 The Contracting Officer has the discretion to determine if an in-person presentation is necessary to reach an informed decision on the issues raised by the protester. An in-person presentation is a fact-finding hearing for the benefit of the College. The College has the discretion to permit attendance at an in-person presentation by those parties likely to be affected by the outcome of the protest. The in-person presentation shall be recorded electronically by the College and the electronic recording shall be available for public access as a "government record" under OPRA.

1B2.5 Any bidder who intends to be represented by an attorney at an in-person presentation must notify the Contracting Officer in advance to give the College an opportunity to have its counsel from the Attorney General's Office, Division of Law, attend in person or by telephone. If advance notification is not provided, the Contracting Officer may limit the bidder's attorney to advising and assisting the bidder by submitting questions to be asked of other participants/witnesses at the discretion of the Contracting Officer. The in-person presentation will not be rescheduled in this situation.

1B2.6 The Contracting Officer may award the Contract immediately, notwithstanding the receipt of a protest, if the failure to award the Contract will result in substantial cost to the College or if public exigency so requires. In such event, the College shall notify all interested parties. Award of the Contract shall be appealable to the Superior Court of New Jersey, Appellate Division, pursuant to N.J.S.A. 18A:3B-6(f).

1B2.7 The College reserves the right to waive any immaterial defects in the bid or the bidding process.

1B2.8 The College shall issue a written decision including findings of fact and conclusions and shall provide copies of the bid protest decision to all participants in the bid protest. The bid protest decision is a final decision of the "Contracting agent", as that term is defined in the State College Contracts Law, N.J.S.A. 18A:64-53(b). Notice of award of the Contract following a bid protest decision shall be provided to all bidders, and shall be appealable to the Superior Court of New Jersey, Appellate Division, pursuant to N.J.S.A. 18A:3B-6(f).

IB3 Bid Modification

IB3.1 A bidder may modify his bid proposal by fax, email or letter at any time prior to the scheduled closing time for receipt of bids, provided such communication is received by the College prior to such closing time. A written confirmation of any bid modification signed by the Bidder must have been mailed and time-stamped by the Post Office prior to specified closing time. Such confirmation shall be accompanied by a newly executed affidavit of non-collusion.

IB3.2 Any bid modification request shall not reveal the basic Bid Price but only shall provide the amount to be added, subtracted or modified so that the final prices or terms will not be revealed until the sealed Proposal is opened. If written confirmation of the bid modification is not received within two (2) business days after the scheduled bid closing time, no consideration will be given to the bid modification request and the Bidder will be held to the original bid proposal amount.

IB3.3 Bids may be withdrawn upon written request received from Bidders prior to the time fixed for the Bid Opening. Right for withdrawal of a bid is lost after a bid has been opened. If any error has been made in the bid amount, request for the relief from the bid may be made in writing to the College. The written request shall be signed by an authorized corporate officer. A determination of whether the Bidder will be released shall be at the sole discretion of the College, who shall issue its finding within five (5) business days of his receipt of all pertinent information relating to such request for relief.

IB4 Consideration of Bids

IB4.1 Award of Contracts or Rejection of Bids:

- a. Contracts will be awarded to the lowest responsible Bidder. The awards will be made, or the bids rejected, within sixty (60) days from the date of the opening of the bids.
- b. All bid deposits of unsuccessful Bidders (except the lowest three (3) Bidders) will be returned or refunded within five (5) days of the bid opening.
- c. The bid security deposits of the successful Bidder and the next two (2) lowest bidders will be retained by the College until the execution and delivery of a formal Contract and Performance and Payment Bonds by the low Bidder. At such time bid deposits of the other two (2) low Bidders will be returned.

- d. The College reserves the right to award the Contract upon the basis of a single bid for the entire work. Alternates will be accepted or rejected in numerical sequence as cited in the Bid Documents and shall not be selected at random except as provided herein. Add alternates and deduct alternates will be specified separately. The College may choose from the add and deduct alternates without priority between the two groups so long as selection within each group is in numerical sequence from the first to the last.
- e. The College reserves the right to waive in its sole discretion any bid requirements when such waiver is in the best interests of the College and where such waiver is permitted by law.
- f. The College reserves the right to reject any and all bids when such rejection is in the best interests of the College. The College also may reject the bid of any Bidder who, in its judgment, is not responsible or capable of performing the Contract based on financial capability, past performance, or experience

IB4.2 The Bidder to whom the Contract is awarded shall execute and deliver the requisite Contract Documents including payment and performance bonds within the time specified. Upon his failure or refusal to comply in the manner and within the time specified, the College may either award the Contract to the next low responsible Bidder or re-advertise for new proposals. In either case, the College may hold the defaulting Bidder and his Surety liable for the difference between the applicable sums quoted by the defaulting Bidder and that sum which the College may be obligated to pay to the Contractor who undertakes to perform and complete the work of the defaulting Bidder.

IB5 Awards

IB5.1 In executing a contract, a successful bidder agrees to perform his work in a good and workmanlike manner to the reasonable satisfaction of the College and to complete all work within the contract duration as defined in the contract documents.

IB5.2 Successful Bidders will be notified of the time and place for the signing of Contracts. Key requirements in the conduct of the Contract, including, but not limited to, the number of days for performance of the Contract, manner and schedule of payments and other administrative details will be reviewed at the award meeting. The time and place of the first job meeting also will be announced.

IB6 Qualification of Bidders

IB6.1 If the successful Bidder is a corporation, not organized under the laws of the State of New Jersey, or is not authorized to do business in this State, the Award of the Contract shall be conditioned upon the prompt filing by the said corporation of a Certificate to do business in this State and complying with the laws of this State in that regard. This filing must be made within the Department of Treasury, Division of Revenue. No Award of Contract will be made until the Department of State confirms this authorization.

IB6.2 The College reserves the right to reject a Bidder at any time prior to the signing of a Contract if information or data is obtained which, in the opinion of the College, adversely affects the responsibility and/or the capability of the Bidder to undertake and to complete the work regardless of the Bidder's previous qualification or classification. The College may conduct any investigation as it deems necessary to determine the Bidder's responsibility and capacity and the Bidder shall furnish all information and data for this purpose as the College may request.

IB6.3 Bidder and the following Subcontractors must be pre-qualified with the New Jersey Department of Property Management and Construction for their respective trade classification and dollar amount of their bid amount:

- (1) General Construction – Alterations and Additions
- (2) Heating and Ventilating Systems and Equipment
- (3) Electrical Work

The Bidder must include the names of each Subcontractor as requested on the proposal form and include the DPMC Notice of Classification and Uncompleted Contracts Form for the Bidder and each Subcontractor listed above.

IB6.4 Pursuant to N.J.S.A. 52:32-44, the Bidder and Subcontractors listed on the proposal form must have a valid business registration certificate on file with the Division of Revenue. The certificates will be requested prior to the time of contract, purchase order, other contract documents execution.

IB6.5 Pursuant to P.L. 2012, c. 25, any bidder or business entity which, at the time of bid or award of this Contract, is identified on a list created by the N.J. Department of Treasury pursuant to this act as a person or entity engaging in investment activities in Iran as described in this act, shall be ineligible to, and shall not bid on or be awarded a contract for this Project.

IB7 Deposit and Bid Bond

IB7.1 Each proposal shall be accompanied by a Bid bond or by a Certified Check, made payable to the College equal to ten percent (10%) of the total amount of the proposal, as an evidence of good faith, which guarantees that if the proposal submitted by the Bidder is accepted, the bidder will enter into the Contract and furnish the required Contract Documents and Surety Bonds. If a Bid Bond is submitted, it shall also provide that the Surety issuing the Bid Bond be bound to issue the required Payment and Performance Bonds, if the Bidder is awarded the Contract. If the Bidder whose proposal is accepted is unable to provide the Performance and Payment Bonds or fails to execute a Contract, then such Bidder and the Bid Bond Surety shall be obligated to pay to the College the difference between the amount of the bid and the amount which the College contracts to pay another party to perform the work. The College reserves the right to retain any Certified Check deposited hereunder as reimbursement for the difference as aforesaid, and shall return any unrequired balance to the Bidder. Should there be a deficiency in excess of the bid deposit, the Bidder and the Surety shall pay the entire amount of the College's difference in cost upon demand. Nothing contained herein shall be construed as a waiver of any other legal remedies the College may have by reason of a default or breach by the Contractor. Certified Checks or Bonds submitted by unsuccessful Bidders will be returned after the Contract has been executed. Contractors electing to furnish a Bid Bond must include Consent of Surety, both in form acceptable to the College.

IB7.2 Attorneys-in-fact who sign Bid Bonds or Contract Bonds must file a certified Power-of-Attorney with the College indicating the effective date of that power.

IB8 Performance and Payment Bond

IB8.1 The successful Bidder shall furnish within seven (7) calendar days after the issuance of the Notice of Intent to Award Contract the required Performance and Payment Bonds in statutory form in an amount equal to one hundred percent (100%) of the total Contract Price as security for the faithful performance and for the payment of all persons and firms performing labor and furnishing materials in connection with this Contract. The Performance Bond and the Payment Bond must be separate instruments. No Contract shall be executed unless and until each Bond is submitted to and approved by the College and the Surety must be presently authorized to do business in the State of New Jersey.

IB8.2 The cost of Bonds shall be paid for by the respective bidders.

IB8.3 If at any time the College, for justifiable cause, is dissatisfied with any Surety or Sureties who have issued, or propose to issue, the Performance or Payment Bonds, the Contractor shall, within seven (7) calendar days after notice from the College to do so, substitute an acceptable Bond (or Bonds) in such form and sum and executed by such other Surety or Sureties as may be satisfactory to the College. The premiums of such Bond shall be paid by the Contractor. No Contract shall be executed and/or no Payment made under a Contract until the new Surety or Sureties shall have furnished such an acceptance Bond to the College.

IB8.4 Bonds must be legally effective as of the date the contract is signed. Bonds must indicate Contractors' names exactly as they appear on the Contract. Current Attorney-in-Fact instruments and financial statement of the Surety must be included with Bond. Bonds must be executed by an authorized Officer of the Surety. Bonds furnished under this article shall conform in all respects to the requirement and language of N.J.S.A. 2A:44-143 to 147.

IB9 Addenda and Interpretations

IB9.1 No interpretation of the meaning of the Plans, Specifications or other Bid Documents will be provided to any Bidder unless such interpretation is made in writing to all prospective Bidders prior to Bid Opening. Any interpretations not made to all prospective Bidders shall be unauthorized and, not binding upon the College.

IB9.2 Every request for an interpretation or clarification of the Plans, Specifications or other Bid Documents shall be made in writing via e-mail, addressed to Mr. Seamus Doran of Ramapo College, sdoran@ramapo.edu and **Michael Herbst**, ikon.5 Architects, mherbst@ikon5architects.com and must be received by **4 PM local time, Friday, October 16, 2015**. Any and all interpretations or clarifications must be issued by the College, in the form of Addenda and e-mailed to all prospective Bidders no later than seven (7) business days prior to the date of the opening of Bids. All Addenda issued shall become part of the Contract Documents and shall be acknowledged on the Proposal Form. Failure of a Contractor to acknowledge receipt of all such Addenda on the proposal form may result in the Bidder's proposal being considered non-responsive, at the option of the College.

IB9.3 Each Bidder shall be responsible for thoroughly reviewing the Contract Documents prior to submission of bids. Bidders are advised that no claim for expenses incurred or damage sustained on account of any error, discrepancy, omission, or conflict in the contract Documents shall be recognized by the College unless, and only to the extent that, a written request for interpretation, clarification, or correction has been submitted in compliance with section IB9.2, and the matter has not been addressed by the issuance of Addenda interpreting, clarifying and/or correcting such error, discrepancy, omission, or conflict.

IB10 Assignments

IB10.1 The Contractor shall not assign the whole or any part of this Contract without written consent of the College. Money due or to become due the Contractor hereunder shall not be assigned for any purposes whatsoever.

IB11 Federal Excise Taxes and State Sales Tax

IB11.1 Bidders, in preparing their Bids, must take into consideration applicable Federal and State Tax Laws.

IB11.2 Under Chapter 32 of the Internal Revenue Code, an exemption certificate is on file with the Contracting Officer (Number 22-75-005).

IB11.3 Materials, supplies, or services for exclusive use in erecting structures or buildings or otherwise improving, altering or repairing all College-owned property are exempt from the State Sales Tax.

IB11.4 Bidders must make their own determinations as to the current status and applicability of any Tax Laws and the Contractor may make no claim based upon any error or misunderstanding as to the applicability of any Tax Laws.

IB11.5 Purchases or rentals of equipment are not exempt from any tax under the State Sales Tax Act.

IB12 Product “Equivalent” Approval

IB12.1 In accordance with N.J.S.A.18A:64-64, equal products, materials and equipment will be considered by the College for all products, materials and equipment specified in these bid documents regardless if the language “or equal” is not contained in each specification section. However, the process for submitting and receiving approval of proposed equivalent products, materials and equipment is outlined in IB12.2 below.

IB12.2 Should any Bidder wish to propose an equivalent product, material or equipment from a manufacturer that is not listed in the product specification section in order to receive competitive pricing, the Bidder shall submit a “Equivalent” Request for Approval form to the Construction Manager for review by the Architect. Approvals and/or rejections of the proposed products will be published in Addendums during the bidding process. All requests must be submitted no later than **4 PM local time, Friday, October 16, 2015** for consideration. No requests will be accepted after this date or after contract award. Rejection by the Architect of a proposed manufacturer and/or vendor shall be final and not subject to further review.

IB12.3 By submission of a bid, the Bidder confirms that all materials/equipment will be provided by the approved vendors and manufacturers as listed in the specifications and/or published addendums and the submitted bid amount reflects these vendor and manufacturer costs.

IB13 Offer of Gratuities

IB13.1 N.J.S.A. 52:34-19 makes it a misdemeanor to offer, pay or give any fee, commission, compensation, gift or gratuity to any person employed by the State. It is the policy of the College to treat the offer of any gift or gratuity by any company, its officers, or employees, to any person employed by Ramapo College as grounds for debarment or suspension of such company from bidding on and providing work or materials on College contracts.

**RAMAPO COLLEGE OF NEW JERSEY
BID COVER SHEET**

Bid No.: 12-281C

Opening Date: Wednesday, October 28, 2015

Time: 2 PM

Title: Ramapo College of New Jersey
College Commons

The bid documents consist of the following:

BASE BID DOCUMENTS

Construction Documents Specifications
Construction Documents Drawings

This bid consists of the following documents (marked 'X') attached hereto and made part hereof:

☐ *Proposal Form	☒ **DPMC Notice of Classification and Uncompleted Contracts
☐ *Non-Collusion Affidavit	
☐ *Stockholder Disclosure Form	☒ ** Subcontractor Documents:
☐ *Agreement of Surety Form	1. DPMC Notice of Classification and Uncompleted Contracts
☐ *Bid Security Form	2. NJ Public Works Registration Certificate
☐ **NJ Public Works Registration Certificate	3. Plumbing and Electrical Licenses

* Indicates forms that are included in the bid documents which must be returned with the Bid.

** Indicates documents that are not included in the bid documents but must be returned with the Bid.

By signing this form, the bidder acknowledges receipt and submission of the aforementioned checked-off documents.

Name (Printed or Typed)

Signature

Firm Name: _____

**PROPOSAL FORM
RAMAPO COLLEGE OF NEW JERSEY**

Return this proposal in a sealed envelope marked with the Project Bid No. and indicate "Sealed Bid" in the lower left hand corner.

Date: [DATE], 2015

RCNJ Project No.: 12-281C

Proposal Submitted To:

Richard M. Roberts, Contracting Officer
Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, NJ 07430

Project Title: College Commons

This proposal will be accepted no later than **2 PM, Wednesday, October 28, 2015**, after which time all proposals will be publicly opened and read.

Firm Name &
Address

The undersigned propose to furnish all labor and materials as called for in the Bidding Documents for:

BID AMOUNT (BASE BID)

_____ (dollars) (\$ _____).
(Lump Sum all trades)

ADD ALTERNATE PROPOSALS:

None.

DEDUCT ALTERNATE PROPOSALS:

None.

Signature of Principal

Printed Name

BIDDING DOCUMENTS:

Ramapo College of New Jersey
College Commons
RCNJ Project No. 12-281C
Issued for Bid: September 28, 2015

BASE BID DOCUMENTS

Construction Documents Specifications

Construction Documents Drawings

TIME:

The work to be performed under this Contract shall be complete in accordance with the following milestone dates (see section 01 11 05 Time of Completion):

Pricing to hold good through 60 days after bid due date.

The Bidder must complete required information on the original and all supplemental pages of this proposal. If the information is not properly completed and is not received on time, the bid proposal may not be read and may be rejected.

A Certified Check or Bid Bond in amount of 10% of the base bid is required. A bid bond of lesser value is not acceptable and the bid will be considered non-responsive.

Bidders must submit prices for all alternates and unit prices when requested, otherwise the bid will be considered non-responsive.

Having examined the plans and specifications with related documents and the site of the proposed work and being familiar with all of the conditions surrounding the construction of the proposed project including availability of materials and labor, Bidder hereby proposes to furnish all labor and materials, and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the price stated. This price is to cover all expenses incurred in performing the work required under the Contract Documents, of which this proposal is a part.

Bidder hereby agrees to commence work under this contract on or before a date to be specified in written "Notice to Proceed" of the Owner and to fully complete the project as stipulated in the specifications. Bidder further agrees to pay as liquidated damages, a sum for each consecutive calendar day thereafter as provided in the General Conditions.

Bidder acknowledges and affirms review of the valid prevailing wage rates for all trades involved in the project, the geographic location of the project as issued by the Commission of the Department of Labor and Industry, Trenton, NJ 08625, (609) 292-2259.

Signature of Principal

Printed Name

FOR BIDDER

Following are two (2) projects of similar scope and complexity, and value completed by our firm. Bidder acknowledges that the College may contact the Owners or their representatives for references.

1. Owner: _____
Owner Contact: _____ Tel. No.: () _____
Construction Manager: _____
CM Contact: _____ Tel. No.: () _____
Architect: _____
Architect Contact: _____ Tel. No.: () _____
Location: _____
Description: _____
Original Bid Amount: \$ _____
Contract Increases: \$ _____
Original Contract Completion Date: _____
Actual Completion Date: _____
Was Project Free of Claims and Litigation: YES NO
If NO, Please Explain: _____

2. Owner: _____
Owner Contact: _____ Tel. No.: () _____
Construction Manager: _____
CM Contact: _____ Tel. No.: () _____
Architect: _____
Architect Contact: _____ Tel. No.: () _____
Location: _____
Description: _____
Original Bid Amount: \$ _____
Contract Increases: \$ _____
Original Contract Completion Date: _____
Actual Completion Date: _____
Was Project Free of Claims and Litigation: YES NO
If NO, Please Explain: _____

Signature of Principal

Printed Name

LIST OF SUBCONTRACTORS

The Bidder confirms that the Subcontractors listed below will be awarded the subcontract for the work identified if the Bidder is awarded the contract for the Project. The College will not accept any change from the Subcontractors listed unless the listed Subcontractor provides the College with a letter authorizing the Bidder to award a subcontract to another company. The College has the right to reject any subcontractor with no impact to project schedule or bid amount.

Structural Steel and Ornamental Iron Work (DPMC Prequalification Required):

Company Name: _____

City/State: _____

Phone: _____

Contact: _____

Bid Amount: _____

*** Subcontractor is to provide a list of open contracts which supports the amount listed on the DPMC Uncompleted Contracts Form. List shall include project name, firm name that is holding the contract, contact name and information, total contract value, uncompleted value, and expected completion date.**

Plumbing and Gas Fitting Work (DPMC Prequalification Required):

Company Name: _____

City/State: _____

Phone: _____

Contact: _____

Bid Amount: _____

*** Subcontractor is to provide a list of open contracts which supports the amount listed on the DPMC Uncompleted Contracts Form. List shall include project name, firm name that is holding the contract, contact name and information, total contract value, uncompleted value, and expected completion date.**

Heating and Ventilating Systems and Equipment (DPMC Prequalification Required):

Company Name: _____

City/State: _____

Phone: _____

Contact: _____

Bid Amount: _____

*** Subcontractor is to provide a list of open contracts which supports the amount listed on the DPMC Uncompleted Contracts Form. List shall include project name, firm name that is holding the contract, contact name and information, total contract value, uncompleted value, and expected completion date.**

Electrical Work (DPMC Prequalification Required):

Company Name: _____

City/State: _____

Phone: _____

Contact: _____

Bid Amount: _____

*** Subcontractor is to provide a list of open contracts which supports the amount listed on the DPMC Uncompleted Contracts Form. List shall include project name, firm name that is holding the contract, contact name and information, total contract value, uncompleted value, and expected completion date.**

Signature of Principal

Printed Name

Bidder acknowledges receipt of the following Addenda:

Addendum Number

Date of Addendum

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for bids.

Upon receipt of written notice of the acceptance of this bid, Bidder will execute the formal contract within seven (7) calendar days and deliver Performance and Payment Bonds as required in Instructions to Bidders.

The bid security attached in the sum of _____ (\$_____) is to become the property of the State in the event the contract and bond are not executed within the time set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

I certify that our firm is classified by the Division of Property Management and Construction in the approved amount of \$ _____ for _____ (trade), until _____ (expiration date). I further certify that the amount of this bid proposal, including all outstanding incomplete contracts, does not exceed my pre-qualification dollar limit.

Respectfully submitted,

(Seal if bid is by a corporation)

By: _____
(Name of firm)

(Signature)

(Title)

(Business Address)

Telephone No.
Facsimile No.

Any change in ownership information since filing your current financial/experience statement? If yes, attach explanation.

() YES () NO

Federal Identification No.

Social Security No.

RAMAPO COLLEGE OF NEW JERSEY

NON-COLLUSION AFFIDAVIT

Project Title: **College Commons**

STATE OF NEW JERSEY (
 (
COUNTY OF (
)

I, _____ of the City of _____ in the County of _____ and the State of _____ of full age, being duly sworn according to law on my oath depose and say that:

I am _____ of the firm of _____ the bidder making the proposal for the above named project, and that I execute the said Proposal with full authority so to do; that the said bidder has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above named project; and that all statements contained in said proposal and in this affidavit are true and correct, and made with full knowledge that the State of New Jersey relies upon the truth of the statements contained in said Proposal and in the statements contained in this affidavit in awarding the contract for the said project.

Signature

Print Name

Company Name

Subscribed and sworn to before
me the _____ day
of _____ 20__.

Notary Public of

My Commission expires _____, 20__.

RAMAPO COLLEGE OF NEW JERSEY

STOCKHOLDER DISCLOSURE FORM

Firm Name _____

Address _____

City & State _____

In the spaces provided, list the names and addresses of all owners, partners, directors, officers and indirect owners owning 10% or more interest in the bidder's firm. If the Bidder is owned by a corporation, list in the space provided all stockholders whose ownership through the corporation is 10% or more of the corporation. Complete affidavit at bottom of form. If this has already been submitted to Ramapo College, use the form for any changes and complete the affidavit.

NAME	ADDRESS (Street, City/Town, County, State, Zip)

President of the firm (Type or print name) _____ Phone _____

I certify that: _____ List of stockholders names and addresses has been submitted to Ramapo College and it is current and correct to the best of my knowledge, with the exceptions as listed above.

_____ The list of stockholders above is current and correct to the best of my knowledge.

_____ There are no stockholders holding 10% or more interest in this corporation or firm to the best of my knowledge.

Signature of Authorized Representative

Type or print name _____ Title _____

RAMAPO COLLEGE OF NEW JERSEY

AGREEMENT OF SURETY FORM

In consideration of the sum of One Dollar, lawful money of the United States, the receipt whereof is hereby acknowledged, and for other valuable consideration

herein called the Company, consents and agrees that if the project at Ramapo College of New Jersey, Mahwah, New Jersey,

for which the preceding Proposal is made, be awarded to

of

herein called the Bidder, the Company will become bound as surety for its faithful performance and will execute the final bonds required, and if the Bidder shall omit or refuse to execute such Contract when notified or awarded then the Company will pay to Ramapo College of New Jersey, herein called the Obligee, the difference between the amount of the Bidder's bid or proposal, and the lowest amount in excess of said bid, or proposal, for which the Obligee may be able to award said Contract within a reasonable time.

Signed, Sealed and Dated

Surety:

By

RAMAPO COLLEGE OF NEW JERSEY

BID SECURITY FORM

Know all Men by These Presents, that we, the undersigned,

as Principal, and

as Surety, are hereby held and firmly bound unto Ramapo College of New Jersey, as Owner in the penal sum of

_____ Dollars

(\$_____) for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed, this _____ day of _____, 20____.

The condition of the above obligation is such that whereas the Principal has submitted a bid for the Ramapo College of New Jersey, Mahwah, New Jersey,

Now therefore if said Bid shall be rejected, or in the alternate, if said Bid shall be accepted and the Principal shall execute and deliver a Contract properly completed in accordance with said Bid and shall furnish a bond for the faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith and shall in all other respects perform the agreement created by the acceptance of said Bid, then his obligation shall be void, otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event, exceed the penal amount of this obligation as herein stated.

IN WITNESS THEREOF, the Principal and Surety have duly executed this Bond under seal the date and year above written.

SEAL

_____ (L.S.)
Principal

Surety

By

CONTRACT FOR CONSTRUCTION

Agreement made on [DATE] between **Ramapo College of New Jersey** (the "Owner") as the project owner, and (the "Contractor") as the Construction Contractor.

Contractor:

Address:

Project: Ramapo College of New Jersey
College Commons
RCNJ Project No. 12-281C

1. **EMPLOYMENT OF CONTRACTOR/PROJECT DESCRIPTION:** The Owner employs the Contractor and the Contractor agrees to perform all obligations described in the Contract Documents (as defined herein) as required in connection with the construction of the project identified above (the "Project").
2. **CONTRACT DOCUMENTS:** The Contract evidenced by this Agreement includes and incorporates by reference the Contract Documents, as follows:
 - a. Contractor's Bid
 - b. This Agreement
 - c. Construction Documents Specifications
 - d. Construction Document Drawings
 - e. Bid Addendums
 - f. Applicable Prevailing Wage Rates Determined by N.J. Department of Labor
3. **PROJECT PARTICIPANTS:** The following have been designated or retained by the Owner as project participants:

3.1. Contracting Officer:

Name: Richard M. Roberts
Title: Associate Vice President for Administration and Finance,
Contracting Officer
Address: Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, New Jersey 07430
Telephone Number: (201) 684-7616

3.2 Project Manager:

Name: **[PERSON]**
Address: Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, New Jersey 07430
Telephone Number: (201) 788-4558

The Owner may replace any of these participants upon written notice to the Contractor.

4. **CONTRACT PRICE:** The Contractor shall be paid \$_____ (the “Contract Price”) for the complete performance of this Contract, in accordance with the payment provisions set forth in the Contract Documents.
5. **SCOPE OF WORK:** The Contractor shall assume full responsibility for constructing and completing the Work described in the Contract Documents, including providing all labor, subcontractors, services, materials and equipment required, and providing all supervision, management, and scheduling required in the Contract Documents.
6. **CONTRACT TIMES:** It is agreed that time is of the essence for all dates and durations specified for the start of construction and the substantial completion and final completion of the Project.
7. **CONSTRUCTION START:** The Work shall commence on the project site no later than seven (7) calendar days after the Owner issues a Notice to Proceed.
8. **SUBSTANTIAL COMPLETION:** It is agreed that the Contractor shall achieve Substantial Completion as follows: (30) calendar days after permits received.
9. **FINAL COMPLETION:** It is agreed that all work performed pursuant to this Contract and all contractual obligations of the Contractor shall be finally completed within 30 calendar days after the date of Substantial Completion. All requirements for final completion are set forth in the Contract Documents.
10. **NOTICES:**

Notice to the Contractor: Written notice required to be given to the Contractor under this Contract shall be addressed to:

Notice to the Owner: Written notice required to be given to the Owner under this Contract shall be addressed to both:

Richard M. Roberts, Contracting Officer
Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, New Jersey 0743

[PERSON], Project Manager
Ramapo College of New Jersey
505 Ramapo Valley Road
Mahwah, New Jersey 0743

11. **CONTRACT TERMS, CHANGES, AND LAW:** This Agreement and the Contract Documents incorporated by reference herein constitute the entire agreement between the Owner and the Contractor, and shall be governed by the laws of the State of New Jersey, including, without limitation, the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1, *et seq.*, including the notice and time of suit provisions of the Act. The terms and conditions of this Contract may not be changed except by a writing signed by duly-authorized representatives of the Contractor and the Owner.
12. **PREVAILING WAGE STATUTE:** The Contractor and all subcontractors must comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 *et seq.* and the regulations promulgated thereunder. Workers employed by the Contractor or any subcontractor or sub-subcontractor in the performance of services directly on the Project must be paid prevailing wages at the applicable rates as determined by the NJ Department of Labor, which rates are set forth in the Contract Documents and incorporated herein by reference. As provided by N.J.S.A. 34:11-56.27, the Contractor or any subcontractor may be terminated if any covered worker is not paid the applicable prevailing wages on the Project, and the Contractor and its surety shall be liable to the Owner for any additional costs which result therefrom. The Contractor is advised that the applicable wage rates may change over the life of the Contract, and that payment by the Contractor and all subcontractors to all covered workers shall be in accordance with any rate changes instituted over the life of the Contract. The Contractor shall regularly consult the New Jersey Department of Labor's Prevailing Wage Website http://lwd.dol.state.nj.us/labor/wagehour/wagerate/prevailing_wage_determinations.html for changes to prevailing wage rates.
13. **DISCRIMINATION IN EMPLOYMENT:**
 - 13.1 Covenants Required by N.J.S.A. 10:2-1

- a. In the hiring of persons for the performance of work under this Contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this Contract, no contractor, nor any person acting on behalf of such contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;
 - b. No contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this Contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;
 - c. There may be deducted from the amount payable to the Contractor by the College, under this contract, a penalty of \$50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the Contract; and
 - d. This Contract may be canceled or terminated by the College, and all money due or to become due hereunder may be forfeited, for any violation of this section of the Contract occurring after notice to the contractor from the College of any prior violation of this section of the Contract.
- 13.2 The Contractor and any subcontractors employed by it shall comply with N.J.S.A. 10:2-1 through 10:2-4 and N.J. S.A. 10:5-1 et seq., including N.J.S.A. 10:5-31 through 35, which prohibit discrimination in employment in public contracts. The statute and the rules and regulations promulgated thereunder shall be considered to be part of this Contract and binding upon the Contractor and its subcontractors. If the Owner is notified of any violation of the public contract awarding regulations in accordance with N.J.A.C. 17:27-7.4 concerning the financing of minority and women outreach and training programs, the Owner reserves the right to deduct the outreach and training allocation from the contract.
- 13.3 N.J.S.A. 10:5-33 and N.J.A.C. 17:27-3.5 require that during the performance of this contract, the contractor must agree as follows:

- a. The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will take affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause;
- b. The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex;
- c. The contractor or subcontractor where applicable, will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

13.4 N.J.A.C. 17:27-3.8 requires that during the performance of this contract, the contractor must agree as follows:

- a. When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Division may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by (a)1i and 2 below, as long as the Division is satisfied that the contractor or

subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Division that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. 17:27-7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

- i. If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 *et seq.*, as supplemented and amended from time to time. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities to minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the procedures prescribed under (a)2 below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.
- b. If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (a)1 above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:
 - i. To notify the public agency compliance officer, the Division, and minority and women referral organizations listed by the Division

pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

- ii. To notify any minority and women workers who have been listed with it as awaiting available vacancies;
- iii. Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;
- iv. To leave standing requests for additional referral of minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State training and employment service and other approved referral sources in the area;
- v. If it is necessary to lay off any of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this chapter, as well as with applicable Federal and State court decisions;
- vi. To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:
 - (1) The contractor or subcontractor shall interview the referred minority or women worker.
 - (2) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience as recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Division. If necessary, the contractor or subcontractor shall

consider the recruitment and hiring or scheduling of minority and women workers who qualify as trainees pursuant to these rules. All of these requirements, however, are limited by the provisions of (a)3 below.

- (3) The name of any interested woman or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (a)2vi(2) above, whenever vacancies occur. At the request of the Division, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.
 - (4) If, for any reason, a contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Division.
- vii. To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Division and submitted promptly to the Division upon request.
- c. The contractor or subcontractor agrees that nothing contained in (a)2 above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (a)2 above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey workers ratio specified in the applicable collective bargaining

agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (a)2 above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

- d. After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Division an initial project workforce report (Form AA201) electronically provided to the public agency by the Division, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer. The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

- 14. COMPLIANCE WITH PROCUREMENT STATUTES:** The Contractor warrants and represents that this Contract has not been solicited or secured, directly or indirectly, in a manner contrary to the laws of the State of New Jersey, and in particular the provisions of N.J.S.A. 18A:64-6.1, 6.2 and 6.3, and that the Contractor has not and shall not violate the laws of the State of New Jersey relating to the procurement of or the performance of this Contract by any conduct, including the paying of any gratuity of any kind, directly or indirectly, to any public employee or officer. Any violation of this provision shall be cause for the Owner to terminate this Contract, to retain all unpaid and/or unearned monies, and to recover all monies paid. The Contractor shall notify the Owner in writing of any interest which any officer, employee or consultant of the Owner has in, or association with, any contractor, subcontractor, material supplier, consultant, or manufacturer, or other party which has any interest in this project.

ATTEST:

Ramapo College of New Jersey

(Seal)

By _____
Richard M. Roberts
Associate VP for Administration and Finance
Contracting Officer

Date _____

ATTEST:

Owner Contractor Agreement

(Seal)

By_____

Date_____

RAMAPO COLLEGE OF NEW JERSEY

PERFORMANCE BOND FORM

BOND NO. _____

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned
as Principal, and _____, a corporation of the State of _____,
duly authorized to do business in the State of New Jersey, having an office at _____
are hereby held and firmly bound unto RAMAPO COLLEGE OF NEW JERSEY in the penal sum of
(\$ _____) DOLLARS, for the payment of which well and truly to be made, we hereby jointly and
severally bind ourselves, our heirs, executors, administrators, successors and assigns.
Signed this _____ day of _____ 20____

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, the above named
Principal did on the _____ day of _____ 20____ enter into a written contract with **RAMAPO
COLLEGE OF NEW JERSEY**

which said contract is made a part of this bond the same as though set forth herein;

NOW, if the said principal,
shall well and faithfully do and perform the things agreed by Ramapo College of New Jersey to be done and
performed according to the terms of the said contract, then this obligation shall be void; otherwise the same
shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety
for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein
stated.

The said surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms
of the said contract, or in or to the plans or specifications therefore shall in anywise affect the obligation of
said surety on its bond.

This bond is given in compliance with the requirements of the statutes of The State of New Jersey in respect
to bonds of contractors on public works. Revised Statutes of New Jersey, 1937, Sections 2A:44-143-147,
and amendments thereof, and liability hereunder is limited as in said statutes provided.

**SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF**

Witness

BY:

Witness as to Surety

BY:

Attorney-in-Fact

Countersigned this _____ day of _____ 20____

BY: _____

Note: General Power of Attorney and the Current Financial
Statement of the bonding company must be attached to each
copy of the Performance Bond.

RAMAPO COLLEGE OF NEW JERSEY

PAYMENT BOND FORM

BOND NO. _____

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned
as Principal, and _____, a corporation of the State of _____,
duly authorized to do business in the State of New Jersey, having an office at _____
are hereby held and firmly bound unto RAMAPO COLLEGE OF NEW JERSEY in the penal sum of
(\$ _____) DOLLARS, for the payment of which well and truly to be made, we hereby jointly and
severally bind ourselves, our heirs, executors, administrators, successors and assigns,
signed this _____ day of _____ 20____

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, the above named
Principal did on the _____ day of _____ 20__ enter into a written contract with **RAMAPO
COLLEGE OF NEW JERSEY**

which said contract is made a part of this bond the same as though set forth herein:

NOW, if the said principal,
shall pay all lawful claims of subcontractors, materialmen, laborers, persons, firms or other suppliers or
corporations for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils,
implements or machinery furnished, used or consumed in the carrying forward, performing or completing of
said contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor,
materialman, laborer, person, firm or corporation having a just claim as well as for the obligee herein; then
this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly
understood and agreed that the liability of the surety for any and all claims hereunder shall in no event
exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms
of the said contract, or in or to the plans or specifications therefore shall in anywise effect the obligation of
said surety on its bond.

This bond is given in compliance with the requirements of the statutes of The State of New Jersey in respect
to bonds of contractors on public works. Revised Statutes of New Jersey, 1937, Sections 2A:44-143-147,
and amendments thereof, and liability hereunder is limited as in said statutes provided.

**SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF**

Witness

BY:

Witness as to Surety

BY:

Attorney-In-Fact

Countersigned this _____ day of _____ 20____

BY: _____

Note: General Power of Attorney and the Current Financial
Statement of the bonding company must be attached to each
copy of the Performance Bond.

RAMAPO COLLEGE OF NEW JERSEY

RETAINAGE BOND FORM

BOND NO. _____

KNOW ALL PERSONS BY THESE PRESENTS that [NAME OF CONTRACTOR], as Principal, and the undersigned surety, are held and firmly bound unto RAMAPO COLLEGE OF NEW JERSEY as Obligee, in the amount of TWO PERCENT (2%) of the total amount paid the Principal under the contract, including any increases due to change orders, quantities of work, new items of work, or other additions as the Obligee may pay under the Contract, lawful money of the United States, well and truly to be paid to RAMAPO COLLEGE OF NEW JERSEY, and we bind ourselves, our heirs, successors, executors, and administrators jointly and severally, firmly by these presents.

Whereas, the Principal has entered into a contract for the above-referenced project with RAMAPO COLLEGE OF NEW JERSEY and;

Whereas, under the contract, the Principal is required before commencing the work provided for in the contract to execute a bond in the above amount;

Now therefore, the condition of this obligation is such that if the Principal and its heirs, successors, executors, and administrators shall fully indemnify and save harmless RAMAPO COLLEGE OF NEW JERSEY from all costs and damages from valid claims filed within 90 days of notification of final acceptance of the work under the contract by any person or entity against the contract funds, and shall fully reimburse RAMAPO COLLEGE OF NEW JERSEY for amounts owed by the **Principal** to RAMAPO COLLEGE OF NEW JERSEY with regard to the contract after notification of final acceptance of the work, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

Provided further, that the said surety(ies) for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract, or to the work to be performed thereunder, or the Specifications accompanying the same, shall in anywise affect its obligation on this bond. The surety(s) does hereby waive notice of any such change, extension of time, alteration or addition, to the terms of the Contract or to the work or to the Specifications, unless otherwise specified in the contract.

WITNESS our hand this, _____ day of, 20____.

CONTRACTOR

(Firm Name and Seal)

(Print Name and Title)

(Signature)

SURETY

(Firm Name and Seal)

(Print Name and Title)

(Signature)

*NOTE: A Power of Attorney, showing that the surety officer or Attorney-In-Fact has authority to sign such obligation, must be impressed with the corporate seal and attached behind the Retainage Bond in each contract.

Ramapo College of New Jersey
Project - College Commons

RCNJ Project No. 12-281C

Change Request No. _____
Date: _____

CONTRACTOR CHANGE ORDER PROPOSAL FORM

Contractor Name: _____
Address: _____
Telephone No.: _____

SECTION A: DETAILED DESCRIPTION OF THE WORK: _____

SECTION B: SELF PERFORMED WORK		PM REVISIONS	
1. Total Labor (from Labor Worksheet)		\$0.00	
2. Total Material (from Material Worksheet)		\$0.00	
3. Total Equipment (from Equipment Expense Proposal)		\$0.00	
4. Subtotal (total lines 1 through 3)		\$0.00	
5. Contractor's Mark-up Combined Overhead and Profit (10% of line 4)		\$0.00	
6. SELF PERFORMED WORK TOTAL (Total lines 4 and 5)		\$0.00	

SECTION C: SUBCONTRACTOR WORK		(From Subcontractor's Proposal - provide subcontractor proposal forms)	
7. Names of Subcontractors:		Base Cost Only	10% Markup
A. _____			\$0.00
B. _____			\$0.00
C. _____			\$0.00
D. _____			\$0.00
8. TOTAL SUBCONTRACTORS' PROPOSALS	\$0.00		\$0.00
9. General Contractor's 5% Markup on Subs' Cost (per General Conditions)			\$0.00
10. SUBCONTRACTOR TOTAL			\$0.00

SECTION D: CONTRACTOR'S REQUESTED TOTAL

11. AMOUNT REQUESTED (Total lines 6 and 10) \$0.00

Signature of Contractor's Authorized Representative _____ Date _____

Print Name _____

Print Title _____

SECTION E: PROJECT MANAGER'S REVIEW

I have reviewed the labor hours, material quantities and equipment and (check one):

_____ no exceptions are taken to this Proposal.

_____ see comments noted on proposal or below. _____

By: _____

Project Manager Date

Ramapo College of New Jersey
Project - College Commons

RCNJ Project No. 12-281C

Change Request No. _____
Date: _____

CHANGE ORDER MATERIAL WORKSHEET

Contractor Name:	_____
Address:	_____ _____ _____
Telephone No.:	_____ _____

[illegible]

RAMAPO COLLEGE OF NEW JERSEY

ATTACHMENT TO APPLICATION FOR PAYMENT

Project Name College Commons

RCNJ Project Number 12-281C

Application for Payment Number _____

I, _____, the General Contractor working for Ramapo College of New Jersey on the above mentioned project, hereby certify as required by P.L. 1991, c. 507 of the State of New Jersey that (check all appropriate paragraphs):

- ☐ all my subcontractors and suppliers have been paid all amounts due from all previous progress payments I have received from Ramapo College of New Jersey for my work on this project;
- ☐ all my subcontractors and suppliers shall be paid all amounts due from this progress payment;
- ☐ all my subcontractors and suppliers shall be paid all amounts due from this progress payment with the exception of those listed below for which payment is being withheld as there exists a valid basis for those subcontractors and suppliers listed below under the terms of their contract(s) to withhold payment from each such subcontractor and supplier:

1. _____
2. _____
3. _____

For each such subcontractor and supplier for which payment is being withheld, I further certify that written notice detailing the specific reason(s) for withholding payment has been provided to each such subcontractor and supplier with copies thereof provided to my performance bond company and Ramapo College of New Jersey.

Signature

Print Name

Company Name

Date

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS
(for Contractor and Subcontractor's Use for Weekly and Final Certification)
(N.J.A.C. 12:60-2.1 and 6.1)

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐		ADDRESS		DATE WAGES DUE		DATE WAGES PAID												
PAYROLL NO.	WEEK ENDING / /	OR FINAL CERTIFICATION ☐	PROJECT NAME AND LOCATION					CONTRACTOR REGISTRATION NUMBER										
1. NAME AND ADDRESS OF EMPLOYEE	2. WORK CLASSIFICATION	Straight time (ST) or Overtime (OT) ☐	3. DAY AND DATE				4. TOTAL HOURS	5. RATE OF PAY	6. GROSS AMOUNT EARNED				7. DEDUCTIONS				8. NET WAGES PAID FOR WEEK	9. Total Fringe Benefit Cost/Hr.
			HOURS WORKED EACH DAY						This Project Only	Total for Week	FICA	With- holding Tax	Total Deduc- tions					
		OT																
		ST																
		OT																
		ST																
		OT																
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Questions? Please contact the Division of Wage and Hour Compliance at (609) 292-2259 or (609) 292-2283.

SUBMIT TO PUBLIC BODY OR LESSOR

Date _____

I, _____
(Name of signatory party) _____
(Title)
do hereby state and certify:

(1) That I pay or supervise the payment of the persons employed by _____
on the _____
(Contractor or Subcontractor) _____
(Project Name and Location)
that during the payroll period beginning on _____, and ending on _____, all persons employed
(Date) (Date)
on said project have been paid the full weekly wages earned, that no rebates have been or will be made either
directly or indirectly to or on behalf of said _____
(Contractor or Subcontractor)

from the full weekly wages earned by any person and that no deductions have been made either directly or
indirectly from the full wages earned by any person, other than permissible deductions as defined in the New Jersey
Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. and Regulation N.J.A.C. 12:60 et seq. and the Payment of
Wages Law, N.J.S.A. 34:11-4.1 et seq.

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct
and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage
rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for
each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered with the United States Department
of Labor, Bureau of Apprenticeship and Training and enrolled in a certified apprenticeship program.

(4) That:

- (a) ☐ WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS OR PROGRAMS
☐ In addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above
referenced payroll, payments of fringe benefits as listed in the contract have been or will be
made when due to appropriate programs for the benefit of such employees, except as noted in
Section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

- ☐ Each laborer or mechanic listed in the above referenced payroll has been paid as indicated on
the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the
amount of the required fringe benefits as listed in the contract, except as noted in Section 4(c)
below.

(c) FRINGE BENEFITS

EXCEPTIONS (CRAFT)
REMARKS
PLEASE SPECIFY THE TYPE OF BENEFIT PROVIDED AND NOTE THE TOTAL COST PER HOUR IN BLOCK 9 ON THE REVERSE SIDE*
1) Medical or hospital coverage ☐
2) Dental coverage ☐
3) Pension or Retirement ☐
4) Vacation, Holidays ☐
5) Sick days ☐
6) Life Insurance ☐
7) Other (Explain) ☐
* TO CALCULATE THE COST PER HOUR, DIVIDE 2,000 HOURS INTO THE BENEFIT COST PER YEAR PER EMPLOYEE.

(5) N.J.S.A. 12:60-2.1 and 6.1 – The Public Works employers shall submit to the public body or lessor a
certified payroll record each pay period within 10 days of the payment of wages.

NAME AND TITLE
SIGNATURE
THE FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. N.J.S.A. 34:11- 56.25 ET SEQ. AND N.J.A.C. 12:60 ET SEQ. AND N.J.S.A. 34:11-4.1 ET SEQ.

State Of New Jersey
Department of Labor & Workforce Development
Construction EEO Compliance Monitoring Program

MONTHLY PROJECT WORKFORCE REPORT - CONSTRUCTION

For instructions on completing the form, go to:

http://www.state.nj.us/treasury/contract_contract_compliance/pdf/aa202ins.pdf

1. Name and address of Prime Contractor

3. F ID or SS Number

4. Reporting Period

2. Contractor ID Number

(NAME)

Date of Award

(ADDRESS)

6. Name and Location of Project

County

7. Project ID Number

(CITY)

(STATE)

(ZIP CODE)

8. CONTRACTOR NAME (LIST PRIME CONTRACTOR WITH SUBS FOLLOWING)	9. PERCENT OF WORK COMPLETED	10. TRADE OR CRAFT	CLASSI- FICATION (SEE REVERSE)			11. NUMBER OF EMPLOYEES					12. TOTAL NO. OF MIN. EMP.			13. WORK HOURS			14. % OF WORK HRS			15. CUM. WORK HRS			16. CUM. % OF W/H		
						A.	B.	C.	D.	E.	F.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.
						TOTAL	BLACK	HISPANIC	AMERICAN INDIAN	ASIAN	FEMALES														
			J																						
			AP																						
			J																						
			AP																						
			J																						
			AP																						
			J																						
			AP																						
			J																						
			AP																						

17. COMPLETED BY (PRINT OR TYPE)

(NAME)

(SIGNATURE)

(TITLE)

(AREA CODE)

(TELEPHONE NUMBER)

(EXT.)

(DATE)



SUBMITTAL TRANSMITTAL

Project: _____ Date: _____
A/E Project Number: _____

TRANSMITTAL To (Contractor): _____ Date: _____ Submittal No. _____
A From (Subcontractor): _____ By: _____ ☐ Resubmission

Qty.	Reference / Number	Title / Description / Manufacturer	Spec. Section Title and Paragraph / Drawing Detail Reference

- ☐ Submitted for review and approval
☐ Resubmitted for review and approval
☐ Complies with contract requirements
☐ Will be available to meet construction schedule
☐ A/E review time included in construction schedule

- ☐ Substitution involved - Substitution request attached
☐ If substitution involved, submission includes point-by-point comparative data or preliminary details
☐ Items included in submission will be ordered immediately upon receipt of approval

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (A/E): _____ Attn: _____ Date Rec'd by Contractor: _____
B From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

- ☐ Approved
☐ Approved as noted

- ☐ Revise / Resubmit
☐ Rejected / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Contractor): _____ Attn: _____ Date Rec'd by A/E: _____
C From (A/E): _____ ☐ Other By: _____ Date Trnsmt'd by A/E: _____

- ☐ Approved
☐ Approved as noted
☐ Not subject to review
☐ No action required
☐ Revise / Resubmit
☐ Rejected / Resubmit
☐ Approved as noted / Resubmit

- ☐ Provide file copy with corrections identified
☐ Sepia copies only returned
☐ Point-by-point comparative data required to complete approval process
☐ Submission Incomplete / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Subcontractor): _____ Attn: _____ Date Rec'd by Contractor: _____
D From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ One copy retained by sender



Advancement
of Construction
Technology

SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST

Project: _____ From (Contractor): _____

Date: _____
To (A/E): _____ A/E Project Number: _____

Contract For: _____

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. Attach supplemental sheets if necessary.

Section Number	Section Title	Firm	Address	Phone Number (Fax Number)	Contact

☐ Attachments

Signed by: _____

Date: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 00 70 00 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ramapo College of New Jersey General Conditions

1.2 GENERAL CONDITIONS

- A. Attached are the Ramapo College of New Jersey contract general conditions (pages 1 through 63).

- END OF SECTION 00 70 00 -

Ramapo College of New Jersey

General Conditions

Article 1	Contract Documents 1.1 Definitions 1.2 Intent of the Contract	Pages 4-7
Article 2	Contracting Officer 2.1 Contracting Officer's Right to Stop Work 2.2 Contracting Officer's Right to Perform Work 2.3 Contracting Officer's Right to Terminate 2.4 Review of Contractor Claims and Disputes 2.5 College Representation 2.6 Ownership and Use of Documents	Pages 8-10
Article 3	Construction Manager and Architect/Engineer 3.1 Construction Manager and Architect/Engineer 3.2 Administration of the Contract 3.3 Substantial and Final Completion Inspections	Pages 11-12
Article 4	The Contractor 4.1 Review of Contract 4.2 New Jersey Prevailing Wage Act 4.3 Supervision and Construction Procedures 4.4 Responsibility for the Work 4.5 Permits, Laws, and Regulations 4.6 Storage, Daily Cleaning, Final Cleanup, and Touchup 4.7 Interruptions to Existing Services 4.8 Working Hours and Standby Personnel 4.9 Record Documents 4.10 Shop Drawings, Product Data, and Samples 4.11 Coordination Drawings 4.12 Demolition, Cutting and Patching 4.13 Tests and Inspections 4.14 Equipment and Material 4.15 Soil Borings 4.16 Protection of Contractor's Property 4.17 Patents 4.18 Right to Audit 4.19 Photographs 4.20 Daily Reports 4.21 Warranties and Guarantees 4.22 Indemnification 4.23 Contractor's Claims for Damages 4.24 Layout, Dimensional Control and Verification, Surveyor's Certification 4.25 Project Sign 4.26 Use of Premises 4.27 Roads and Walkways	Pages 13-27
Article 5	Subcontractors 5.1 Contractor-Subcontractor Relationship	Pages 28

Article 6	Special Requirements	Pages 29-30
	6.1 Construction Access Limitations	
	6.2 Equipment/Material Loading and Debris Removal	
	6.3 Exterior Overhead Protection	
	6.4 Contractor and Subcontractor Identification	
	6.5 Campus Dining Facilities	
	6.6 No Smoking	
	6.7 Contractor Parking	
	6.8 Site Web Camera System	
	6.9 Elevator Use for College	
	6.10 Utility Survey Prior to Excavation and Cutting	
	6.11 Building Enclosure	
	6.12 Commissioning	
	6.13 Hot Work Permits	
	6.14 Excess and Stored Soil	
	6.15 Concrete Slabs	
Article 7	Temporary Facilities, Utilities, and Services	Pages 31-33
	7.1 Field Offices	
	7.2 Storage Sheds, Tool Sheds, Shops, Employee Sheds	
	7.3 Site Logistics	
	7.4 Temporary Toilet Facilities	
	7.5 Temporary Water	
	7.6 Temporary Light and Power	
	7.7 Temporary Heat, Cooling and Dehumidification	
	7.8 Temporary Enclosures and Partitions	
	7.9 Temporary Utility Capping	
	7.10 Temporary Construction Fencing	
	7.11 Dumpsters	
Article 8	Relationship Between The Contractor and Other College Contractors	Pages 34
	8.1 College's Right to Perform Work	
	8.2 Mutual Responsibility	
Article 9	Time	Pages 35-39
	9.1 Notice to Proceed	
	9.2 Adjustment of Contractor Completion Time	
	9.3 Delays - Damages Against the College - Limitations	
	9.4 Liquidated Damages	
	9.5 Contractor Officer's Right to Accelerate	
	9.6 Substantial Completion	
Article 10	Payments and Completion	Pages 40-43
	10.1 Contractor Payments from the College	
	10.2 Final Application for Payment	
	10.3 Interest	
	10.4 Payment Disputes - Claims Against the College	
Article 11	Uncovering and Construction of Work	Pages 43-45
	11.1 Uncovering of Work	
	11.2 Correction of Work	
	11.3 Acceptance of Defective or Nonconforming Work	
Article 12	Protection of Persons and Property	Pages 46-47

	12.1 Safety Precautions and Programs	
	12.2 Safety of Persons and Property	
	12.3 Emergencies	
Article 13	Insurance and Indemnity	Pages 48-49
	13.1 Contractor Insurance Requirements	
	13.2 Insurance to be Carried by The College	
Article 14	Changes in the Work	Pages 50-52
	14.1 Changes to the Contract	
	14.2 Processing of Contractor Requests for Equitable Adjustment	
	14.3 Remedies for Disputed Change Order Proposals	
Article 15	Assignment of Antitrust Claim(s)	Page 53
	15.1 Assignment of Antitrust Claims	
Article 16	Affirmative Action Requirements	Pages 54-56
	16.1 Policy Statement	
	16.2 Mandatory Affirmative Action Requirements	

ARTICLE I

CONTRACT DOCUMENTS

1.1 Definitions

1.1.1 "Architect" or "Engineer" means the Architect or the Engineer (A/E) engaged by the College to act as an authorized representative of the Contracting Officer in regards to designing, supervising the construction of the referenced project and will provide general administration services as described in the A/E Agreement with the College.

1.1.2 Where "as shown", "as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provided complete in place", that is "furnished and installed".

1.1.3 Bulletin or Addendum: "Addenda" are documents issued by the College prior to opening of bids which supplements, revises or modifies the solicitation documents furnished for bidding purposes. "Bulletins" are documents, issued by the College after the opening of bids which supplements, revises or modifies the construction documents.

1.1.4 Change Order Proposal: A proposal for equitable adjustment made by the Contractor in response to written direction by the Contracting Officer.

1.1.5 Claims: Differences between the College and the Contractor concerning extra work, alleged errors or omissions in the specifications or drawings, unreasonable delays, damages to work, informal suspensions or interferences by College Personnel and like matters.

1.1.6 College: Ramapo College of New Jersey.

1.1.7 Construction Manager / Construction Management Firm: One who acts as the College's authorized representative, without assuming any of the Architect/Engineer's contractual, statutory, or customary obligations, and will provide general administration and construction management services as described in the Construction Management Agreement with the College.

1.1.8 "Contract Documents" means this contract, together with any plans, drawings, specifications or other documents which are attached hereto or incorporated herein by reference, together with any such plans, drawings, specifications, schedules, or other documents which may be produced pursuant to this contract or derived therefrom and which are intended to bind the Contractor hereunder.

1.1.9 Contract Limit Lines: refers to those lines shown on the Drawings which limit the boundaries of the Project and beyond which no construction Work or activities shall be performed by the Contractor unless otherwise noted on the Drawings or Specifications.

1.1.10 Contract Line Item Number (CLIN): A specifically described unit of work for which a price is provided in the contract.

1.1.11 "Contractor" means the person or persons, partnership, or corporation named as Contractor in this contract, operating, as an independent contractor and not as an agent of the State in the performance of its functions. Whether referred to as "Contractor", "Prime Contractor", "Prime", "Separate Contractor", or Single Contractor, it shall be understood to mean Contractor. It does not include suppliers or materialmen.

1.1.12 Contracting Officer means the individual authorized, as an officer of the College, to administer the design, engineering and construction of all College Buildings and facilities. He is the Procuring Contracting Officer representing the College personally or through authorized representatives in all relationships with Contractors, Consultants and Architect/Engineers. This includes a duly appointed successor or an authorized Administrative

Contracting Officer (ACO) acting within the limits of its authority.

The Contracting officer is the interpreter of the Conditions of the Contract and the judge of its performance. He shall not take arbitrary positions benefitting either the College or the Contractor, but shall use its powers under the Contract to enforce its faithful performance by both.

1.1.13 Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the contracting officer is intended; and similarly the words "approved", "acceptable", "satisfactory" or words of like import shall mean "approved by", "acceptable to", or "satisfactory to" the contracting officer unless otherwise expressly stated.

1.1.14 DPMC: The "DPMC" is the acronym for the Division of Property Management and Construction, Department of Treasury, State of New Jersey.

1.1.15 Contractor: The Contractor means either the Contractor for General Construction whenever separate prime contractors are involved in a project or the sole Contractor if there are no other prime contractors involved.

1.1.16 "Notice" is a written directive or communication served on the Contractor to act or perform work or carry out some other contractual obligation. It shall be deemed to have been duly served if delivered to an individual or member of the firm or entity or to an officer of the corporation for whom it was intended. This includes delivery by courier or registered or certified mail or telegram to the business address cited in the Contract Documents.

1.1.17 "Plans" means any drawings or reproductions thereof pertaining to the details of the work contemplated by this contract.

1.1.18 "Project" is a general term for identification of the total Contract. It includes the Work and all administrative aspects required to fully satisfy the Contract requirements.

1.1.19 RCNJ's Project Manager: A qualified individual authorized by the Contracting Officer to assist in the administration of a specific construction contract.

1.1.20 Contractor's Project Manager: A qualified individual authorized by the Contractor to assist in the administration of a specific construction contract.

1.1.21 Public Contract: Any contract or agreement entered into by the State of New Jersey or any instrumentality of the State to purchase goods, services, or both.

1.1.22 The terms "Site", "Construction Site" or "Project Site" refer to the geographical area of the entire college campus at which the Work under the Contract is to be performed.

1.1.23 "Specifications" means all written agreements, instructions or other documents in or pursuant to this contract pertaining to the method of performing the work and the results to be obtained.

1.1.24 The words "State", or "Agency of the State" as are used herein mean the State of New Jersey.

1.1.25 "Subcontractor" means the person or persons, partnership, or corporation who enters into a contract with the Contractor for the performance of work under this contract, or the subcontractors of any tier of such individual or corporation.

1.1.26 Substantial Completion: The date the building or facility is operational or capable of serving its intended use even though the project is not complete. Substantial completion is achieved when the Department of Community Affairs issues a Temporary Certificate of Occupancy.

1.1.27 "Systems Assurance" shall mean the totality of all quality control and assurance requirements specified in the contract documents.

1.1.28 "Unit Schedule Breakdown" comprises a detailed list of the work activities required for project construction, other elements associated with fulfilling the requirements of the Contract (bonds, insurance, etc.), major items of material or equipment and the prices associated therewith.

1.1.29 The term "Work" as used herein comprises all construction efforts required by the Contract Documents and includes all supervision, labor, material and equipment necessary to complete such construction.

1.2 Intent of the Contract

1.2.1 The Drawings and Specifications of the Contract are intended to require the Contractor to provide for everything reasonably necessary to accomplish the proper and complete finishing of the work. All Work and Materials included in the Specifications and not shown on the Drawings, or shown on the Drawings and not in the Specifications, shall be performed by the Contractor as if described in both. Any incidental material, and/or work not specified in the Drawings and/or the Specifications which is, nevertheless, necessary for the true development thereof and reasonably inferable therefrom, the Contractor shall understand the same to be implied and required, and he shall perform all such Work and furnish all such materials as if particularly delineated or described therein at no additional cost to the College. Should there be an obvious error or omission in the Drawings or Specifications, it shall be the Contractor's responsibility to complete the Work as reasonably required at no additional cost to the College, consistent with the intent of such Drawings and Specifications as may be interpreted by the Contracting Officer or authorized representative.

1.2.2 Each Contractor shall abide by and comply with the true intent and meaning of the Drawings, the Specifications and other Contract Documents taken as a whole, and shall not avail himself of any unintentional error or omission, should any exist. Should any error, omission or discrepancy appear, or should any doubt exist, or any dispute arise as to the true intent and meaning of the Drawings, the Specifications or other Contract Documents, or should any portion thereof be obscure, or capable of more than one interpretation, the Contractor shall immediately notify the Contracting Officer and seek correction or interpretation thereof prior to commencement of affected Work. The Contracting Officer or authorized representative shall issue its written Interpretation with reasonable promptness. However, the Contractor shall make no claim against the College for expenses incurred or damages sustained on account of any error, discrepancy, omission or conflict in the Contract Documents.

1.2.3 Each and every provision required by law to be inserted in the Contract Documents shall be deemed to have been inserted therein. If any such provision has been omitted or has not been correctly inserted, then upon application of either party, the Contract shall be physically amended to provide for such insertion or correction.

1.2.4 The organization of the Specifications into Divisions, Sections and Articles, and the arrangement of Drawings shall not be construed by the Contractor as being intended to divide or allocate the Work among Subcontractors in any manner or to establish the extent of the work to be performed by any trade. The Contractor is solely responsible for allocation of the contracted work to each Subcontractor regardless if a trade designation is made in the Contract Documents.

1.2.5 The Contractor shall do no Work without proper Drawings and instructions unless authorization to proceed from the Contracting Officer or an authorized representative is received by the Contractor, in writing.

1.2.6 All Drawings referred to, together with such supplementary details as may be furnished and approved from time to time as the Work progresses, are understood as being included as part of the Contract to which they relate.

1.2.7 The sequence of precedence pertaining to interpretation of Contract Documents is as follows:

- a. Executed Contract
- b. Addenda/Bulletin/Insurance
- c. General Conditions
- d. Specifications
- e. Drawings, in following order of precedence:

- (1) Notes on Drawings
- (2) Large scale details
- (3) Figured dimensions
- (4) Scaled dimensions

Where there may be a conflict in the Specifications or Drawings not resolvable by application of the provisions of this paragraph, then the more expensive labor, materials, or equipment shall be assumed to be required and shall be provided by the Contractor at no additional cost to the College.

1.2.8 Where certain work is shown in complete detail, but not repeated in similar detail in other areas of the Drawings, or there is an indication of continuation, the remainder being only shown in outline, the work shown in detail shall be understood to be required in other like portions of the project at no additional cost to the College.

1.2.9 The Contractor shall not, at any time after the execution of its Contract, make any claims whatsoever based upon insufficient data or its incorrectly assumed conditions, nor shall he claim any misunderstandings with regard to the nature, conditions or character of the work to be done under the Contract and he shall assume all risks resulting from any changes in conditions not under the control of the College which may occur during the progress of the Work.

1.2.10 On all Work involving alterations, remodeling, repairs or installation within existing buildings, it shall be the responsibility of the Contractor by personal inspection of the existing building, facility, plant or utility system, to satisfy himself as to the accuracy of any information given which may affect the quantity, size and/or quality of materials required for a satisfactorily completed Contract, whether or not such information is indicated on the Drawings or included in the Specifications. All contracts shall include the cost of all material and labor required to complete the work based on reasonably observable conditions.

ARTICLE 2

CONTRACTING OFFICER

2.1 Contracting Officer's Right to Stop the Work

2.1.1 If the Contractor fails to correct defective Work or persistently fails to carry out the Work in accordance with the Contract Documents, the Contracting Officer or its authorized representative may order the Contractor to stop the work, or any portion thereof, until the cause for such order has been eliminated. Stoppage of the Work shall not render the College liable for claims of any kinds.

2.2 Contracting Officer's Right to Perform Work

2.2.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within three calendar days after receipt of written notice from the Contracting Officer or its authorized representatives to commence and continue correction of such default or neglect with diligence and promptness, the Contracting Officer may, without prejudice to other remedies the Contracting Officer may have, correct such deficiencies. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including College's expenses and compensation for the Construction Manager's and Architect's and their respective consultants' additional services made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the College. Should work be performed by the Contracting Officer under this article, the Contractor will have no cause to void any guarantee on materials or systems installed under this Contract.

2.3 Contracting Officer's Right to Terminate

2.3.1 If the Contractor is adjudged a bankrupt, or if he makes a general assignment for the benefit of its creditors, if a receiver is appointed on account of its insolvency, or if he persistently or repeatedly refuses or fails, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials so as to avoid or eliminate delays in the orderly progress of the Work in accordance with the approved schedule, or if he fails to make prompt payment to Subcontractors or for materials or labor, or persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or if he or any of its Subcontractors is guilty of a substantial violation of a provision of the Contract Documents, or otherwise defaults or neglects to carry out the Work in accordance with the Contract Documents, then the Contracting Officer may, without prejudice to any right or remedy, and after giving the Contractor and its Surety three (3) working days written notice to forthwith commence and continue correction of such default or neglect with diligence and promptness, terminate the employment of the Contractor by the issuance of a written notice to that effect to the Contractor and its Surety at any time subsequent to three (3) working days thereafter, should they, or either of them, fail to comply with the demands of the original three (3) day notice, above mentioned.

2.3.2 Upon such termination the Contracting Officer may take possession of the site and of all the materials, equipment, and tools on the site, and may finish the Work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished. The person or firm designated to carry out such work will be paid as authorized by the Contracting Officer, without entailing any personal liability upon the officers of the College issuing certificates or making such payment.

2.3.3 If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including Liquidated Damages for delays and all consequential damages sustained by the College flowing from such breach of Contract, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor and/or its Surety shall pay the difference to the College, and this obligation shall survive the termination of the Contract.

2.3.4 If, within three (3) working days following receipt of Notice of Termination by the Contractor's Surety, the issuer of the Performance and Payment Bonds, the said Surety exercises its right to take over the Work and

expeditiously commences to prosecute the same to completion, the Contracting Officer shall permit him to do so under the following terms and conditions:

- a. Evidence of the Surety's intention to take over and complete the Contract shall be in writing over the signature of an authorized representative and served upon the Contracting Officer within three (3) days after receipt by the Surety of Notice of Termination.
- b. The execution of a written Agreement between the College, by the Contracting Officer, and the Surety whereby the latter undertakes and assumes the obligation to complete the balance of the Work of its defaulting Contractor in accordance with the terms and conditions of the College Contractor Agreement, to be performed by a substituted Contractor satisfactory to the Contracting Officer, at the Surety's sole cost and expense, and providing for payments to the Surety or to the Substituted Contractor of unpaid Contract balances, if any, then in hands of the College.
- c. The said Agreement shall also expressly provide that the Surety shall not be relieved thereby from any of its obligations under the Performance and Payment Bonds and that it furnish the College with an additional Performance and Payment Bond to secure the faithful performance of the Substituted Contractor.
- d. That all current obligations for labor and materials incurred and outstanding by the defaulting Contractor on this Project be paid without delay, subject to allowance of a reasonable time within which to verify such claims by the Surety; and
- e. That the parties expressly understand and agree that this Agreement is without prejudice and is subject to such rights and remedies as either party (including the Contractor) may elect to assert after final completion and acceptance of the Work.

2.4 Review of Contractor Claims and Disputes

2.4.1 Upon presentation by the Contractor of a request in writing, the Contracting Officer may review any decision or determination of the College or any authorized representative as to any claim, dispute or any other matter or question relating to the execution or progress of the Work or the interpretation of the Contract documents. Consistent with the intent of this contract, the Contracting Officer may schedule a conference for the purpose of settling or resolving such claims, disputes or other matters. Where such a conference is conducted, the Contractor shall be afforded the opportunity to be heard on the matter in question. Following review of the Contractor's request, the College and the Contractor may settle or resolve the disputed matter, provided however that any such settlement or resolution shall be subject to all requirements imposed by law, including where applicable, the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1 et seq.

2.5 College Representation

2.5.1 The College will be represented by a Construction Manager and its staff or other designated representative. The Construction Manager or other designated representative will routinely conduct on-site observations, maintain logs of construction progress and problems encountered; approve Contractor's requisition for payments subject to final approval by the Contracting Officer; conduct job meetings; carry out liaison with the Architect/Engineer and the Contractor; prepare and submit reports on special problems associated with the job; evaluate and process Change Order Requests, and generally remain fully cognizant and be kept informed by the Contractor of

every aspect of ongoing construction. The College's representatives, including the Construction Manager and its staff, have only those duties which are required of an College; responsibility for completion of this project, pursuant to the Contract Documents, remains with the Contractor.

2.6 Ownership and Use of Documents

2.6.1 All Drawings, Specifications and copies thereof furnished by the Architect/Engineer are and shall remain the property of the College. They are reserved to this Project only and are not to be used on any other Project. Submission or distribution of Documents to meet official regulatory requirements or for any other purposes in connection with the Project shall not be construed as derogation of the Architect/Engineer's copyright or other reserved rights.

ARTICLE 3
CONSTRUCTION MANAGER
AND
ARCHITECT / ENGINEER

3.1 Construction Manager and Architect / Engineer

3.1.1 The College may engage a Construction Management firm (Construction Manager) to act as the College's authorized representative, without assuming any of the Architect/Engineer's contractual, statutory, or customary obligations. The Construction Manager will provide general administration and construction management services for the project; and act as a liaison between the College, the Architect/Engineer, and the Contractor.

3.1.2 The Construction Management Firm is responsible for providing construction management services, as described in the Construction Management Agreement, for all contracts entered into by the College, including those relative to the construction and monitoring of the CPM Scheduling of the Project and all of its parts. The Construction Management Firm shall become fully familiar with the contractual obligations of all entities doing work on the Project and all relevant Project documentation, including the design documents prepared by the Architect/Engineer, in order to confirm that the Contractor completes the Project in accordance with its contractual obligations and the College's objectives for cost, time, and quality.

3.1.3 When the College provides a Construction Manager, the role of the Architect/Engineer is that of Consultant to the College and will provide general administration services for the project.

3.1.4 When the College does not provide a Construction Manager, the role of the Architect/Engineer is to provide general administration and construction management services for the project.

3.2 Administration of the Contract

3.2.1 The Architect/Engineer and the Construction Manager will provide administration of the Contract, as hereinafter described.

3.2.2 The Construction Manager and the Architect/Engineer will monitor the execution and progress of the Work and will immediately notify the College of any related problems. The Architect/Engineer and the Construction Manager will at all times be provided access to the Work. The Contractor shall provide facilities for such access so as to enable the Construction Manager and the Architect/Engineer to perform their functions under the Contract Documents.

3.2.3 The Construction Manager and/or the Architect/Engineer will not be responsible for, nor will they have control or charge of, construction means, methods, techniques, sequences of procedures, or safety precautions and programs in connection with the Work. The Construction Manager and/or the Architect/Engineer will not be responsible for, nor have control or charge over, the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other person performing any of the Work, but shall have the obligation to immediately inform the Contracting Officer of any inadequate performance on the project.

3.2.4 The Construction Manager, after consultation with the Architect/Engineer, will recommend the rejection of Work which he believes does not conform to the Contract Documents. Whenever, in its opinion, he considers it necessary or advisable, he may request the Contracting Officer to provide special inspection or testing of the Work, whether or not such Work has been fabricated, installed or completed.

3.2.5 The Construction Manager shall record, track, and if required, set procedures for the processing of Contractor submittals. The Architect/Engineer, will review, approve or take other appropriate action relating to Contractor's submittals, such as Shop Drawings, Product Data and Samples, to assure conformance with the design requirements and the Plans and Specifications of the Work. Such actions shall be taken with reasonable promptness. Approval of a specific item shall not indicate approval of an assembly of which the item is a component.

3.2.6 Both the Architect/Engineer and the Construction Manager will periodically review the Contractor's as built drawings to insure that these are current.

3.3 Substantial and Final Completion Inspections

3.3.1 The Construction Manager and the Architect/Engineer will conduct inspections, accompanied by the Contractor and Contracting Officer's authorized representatives, to determine the dates of Substantial and Final Completion, will receive and forward to the Contracting Officer for its review, written warranties and related documents required by the Contract Documents and assembled by the Contractor, and will approve the issuance of a Certificate of Final Completion.

ARTICLE 4

THE CONTRACTOR

4.1 Review of Contract

4.1.1 The Contractor has the duty and warrants and represents that he has thoroughly examined and is familiar with all the Contract Documents, including but not limited to, the complete set of Drawings and Specifications of the entire project; that he has carefully examined the site and that from its own investigations he has satisfied himself as to the nature and location of the Work, the current local equipment labor and material conditions, and all matters which may in any way affect the Work or its performance. The Contractor is responsible to check and verify reasonably observable conditions outside the Contract Limit Lines to determine whether any conflict exists with the work he is required to perform under the Contract. This includes a check on elevations, utility connections and other site data. As a result of such examination and investigation, the Contractor warrants and represents that he fully understands the intent and purposes of the Contract Documents and its obligations there under and that he accepts responsibility for and is prepared to execute and fulfill completely, by its construction work, the intent of the Contract, without exception and without reservation, at the price and within the timeframe specified in the Contract.

4.1.2 The Contractor shall carefully study and compare the Contract Documents during the progress of the Work and shall immediately report any error, inconsistency or omission to the Construction Manager upon discovery and shall do no work thereafter which may be affected by such error until the College has had the opportunity to respond and clarify the work it wants performed in view of this information. Wherever any error, inconsistency or omission appears, it shall be disposed of pursuant to appropriate procedures set forth elsewhere herein.

4.1.3 Unless otherwise ordered in writing by the Contracting Officer, the Contractor shall perform no portion of the Work without approved Change Orders, approved Shop Drawings or Samples for such portions of the Work, or other approvals as may be applicable and required by the Contract Documents.

4.1.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, equipment, material, tools, construction equipment and machinery, water, heat, utilities, transportation and other facilities and services necessary for the proper execution and completion of the Work, whether or not incorporated or to be incorporated in the Work.

4.1.5 The Contractor shall at all times enforce strict discipline and good order among its employees and shall not employ any unfit person or anyone not skilled in the task assigned to him.

4.1.6 The Contractor shall be obligated to pay the prevailing wage rates as required by the State of New Jersey. The Contractor shall abide by the requirements of the State's Affirmative Action Program. The Contractor also shall be responsible to insure that all principles of Safety are carried out through project completion.

4.2 New Jersey Prevailing Wage Act

4.2.1 Each Contractor or any Subcontractor shall comply with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 and all amendments thereto as this Act is hereby made a part of every Contract entered into on behalf of the College except those contracts which are not within the contemplation of the Act. Provisions of the Act include:

- a. All workmen employed in the performances of every Contract in which the Contract Sum is in excess of \$2,000 and Work to which the College is a party, shall be paid not less than the Prevailing Wage Rate as designed by the Commissioner of the Department of Labor and Workforce Development or its duly authorized representative.

- (1) Each Contractor and Subcontractor performing public work for the College who is subject to the provisions of the Prevailing Wage Act, shall

post the Prevailing Wage Rates for each craft and classification involved as determined by the Commissioner, including the effective date of any changes thereof, in prominent and easily accessible places at the site of the work or at such place or places as are used by them to pay workmen their wages.

- (2) The Contractor's signature on the proposal is its guarantee that neither it, nor any Subcontractor, is currently listed by, or on record with, the Commissioner as one who has failed to pay the Prevailing Wages according to the Prevailing Wage Act.
- b. In the event it is found that any workman, employed by any Contractor or any Subcontractor covered by any Contract in excess of \$2,000 for any public work to which the College is a party, has been paid a rate of wages less than the Prevailing Wage required to be paid by such Contract, the Contracting Officer of the College may terminate the Contractor's or Subcontractor's right to proceed with the work, or such part of the work as to which there has been a failure to pay required wages and may otherwise prosecute the work to completion.
- c. Nothing contained in the Prevailing Wage Act shall prohibit the payment of more than the prevailing wage rate to any workman employed on a public works project.

4.3 Supervision

4.3.1 The Contractor shall supervise and direct the Work using its best skill and attention. The Contractor shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

4.3.2 The Contractor shall employ full-time competent English speaking Project Manager, Superintendent, and assistants who shall be in attendance on the Project site at all times during the progress of the Work. The Project Manager and Superintendent shall represent the Contractor and provide all authorizations on behalf of the Contractor.

4.3.3 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Construction Manager, the name and qualifications of a proposed project manager and superintendent. The Construction Manager may reply in writing stating (1) whether the College, the Construction Manager, or the Architect has reasonable objection to the proposed superintendent or (2) that any of them require additional time to review.

4.3.4 The Contractor shall not employ a proposed project manager and/or superintendent to whom the College, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not change the project manager and/or superintendent without the College's consent, which shall not unreasonably be withheld or delayed. At any time during the project, the College through the Construction Manager may require replacement of the Contractor's project manager and/or superintendent the performance, as judged by the Contracting Officer or its authorized representative, is deemed to be inadequate.

4.3.5 Each Contractor shall employ qualified competent craftsmen in their respective lines of work.

4.3.6 The various Subcontractors shall likewise have competent Superintendents and/or Foremen in charge of their respective portions of the Work at all times. They shall not employ a person unfit or unskilled in the work assigned to him. If it should become apparent that a Subcontractor does not have its portion of the Work under control of a competent Foreman, the Contractor shall have the obligation to take appropriate steps to immediately provide proper supervision.

4.3.7 Should the Contractor not have staff onsite to oversee construction operations, the Construction Manager will have the authority to shut the site down and have all workers removed from site.

4.4 Responsibility for the Work

4.4.1 The Contractor shall be responsible to the Contracting Officer for the acts and omissions of its employees, subcontractors and their agents and employees which injure, damage or delay such other contractors in the performance of their Work. This responsibility is not limited by the applicable provisions stated elsewhere herein, but is in conjunction with, and related thereto.

4.4.2 The Contractor shall be responsible for all damage or destruction caused directly or indirectly by its operations, to all parts of the Work, both temporary and permanent, and to all adjoining property.

4.4.3 The Contractor shall be responsible for costs related to all work when existing conditions are altered without approval from the College and not in accordance with the construction documents.

4.4.4 The Contractor shall, at its own expense, protect all finished Work liable to damage and keep the same protected until the project is completed and accepted. In the case of Substantial Completion accompanied by Beneficial Occupancy by the College, the Contractor's obligation to protect its finished Work shall cease simultaneously with the occupancy of the portion or portions of the structure.

4.4.5 The Contractor shall be responsible for all costs related to additional design services, testing, inspections, and fees for Work incorrectly installed which requires modification or corrective work.

4.4.6 The Contractor shall defend, protect, indemnify and save harmless the College and its authorized representatives from all claims, fines, penalties, suits, actions, damages and costs of every name and description arising out of, or resulting from, the performance of its Work under this Contract. This responsibility is not limited by the provisions of other indemnification provisions included elsewhere herein.

4.4.7 In order to protect the lives and health of its employees, the Contractor shall comply with all applicable statutes and pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on work under the Contract. The Contractor alone shall be responsible for the safety, efficiency, and adequacy of its plant, appliances and methods, and for any damage or injury which may result from its failure or its improper construction, maintenance or operation.

4.5 Permits, Laws, and Regulations

4.5.1 The Contractor shall secure and pay for all permits, governmental fees, and licenses necessary for the proper execution and completion of the Work and which are legally required at the time of receipt of bids except for construction permits and inspections by New Jersey Department of Community Affairs in which the College will make payment for these fees.

4.5.2 All work defined in this Contract is to be done in accordance with the New Jersey Uniform Construction Code. No work requiring inspections and approval of construction code officials is to be covered or enclosed prior to inspection and approval by appropriate code enforcement officials.

4.5.3 The Work under this Contract is exempt from local ordinances, codes and regulations as related to the building and the site on which it is located, except where construction could adversely affect adjacent property, public sidewalks and/or streets. The Contractor shall coordinate its activities with municipal and/or highway authorities having appropriate jurisdiction.

4.5.4 Soil conservation measures are to be in accordance with County Soil Conservation District requirements.

4.5.5 All sewage disposal work shall conform to the regulations of the State Department of Environmental Protection.

4.5.6 The Contractor is responsible to notify the Construction Manager to request code inspections as required to continue progress of the Work in accordance with the construction schedule. The Construction Manager will verify and confirm if the Work is ready for inspection prior to the scheduling of the code inspector. If the work is not ready, the inspection will not be scheduled.

4.5.7 The Contractor shall be responsible for and save harmless the College and its authorized representatives from all fines, penalties or loss incurred for, or by reason of, the violation of any ordinance or regulation or law of the State while the said Work is in process of construction.

4.5.8 The Contractors shall comply with the Federal Occupational Safety and Health Act of 1970 and all of the rules and regulations promulgated there under and NJ Worker and Community Right to Know Act (PL1983 c. 315 N.J.S.A. 34:5A-1, et seq).

4.5.9 As a result of a finding, by an appropriate Finder of Fact, that a Contractor caused a substantial violation of a State, local or federal statute or regulation on said project, the College may declare the Contractor to be in default.

4.5.10 Prior to the start of any crane equipment operations, each Contractor shall make all necessary applications and obtain all required permits from the Federal Aviation Administration (F.A.A.). The Sequence of operations, timing and methods of conducting the work shall be approved by the F.A.A. to the extent that it relates to their jurisdiction.

4.6 Storage, Daily Cleaning, Final Clean Up and Touchup

4.6.1 The Contractor shall confine its apparatus, the storage of its equipment, tools and materials, and its operations and workmen to areas permitted by law, ordinances, permits, contract limit lines as established in the Contract Documents, the rules and regulations of the College, or as ordered by the Contracting Officer or its authorized representative, and shall not unreasonably encumber the site or the premises with its materials, tools and equipment. At no times shall the Contractor use existing occupied spaces as storage.

4.6.2 The Contractor shall at all times during the Progress of the Work keep the premises and the job site free from the accumulation of all refuse, rubbish, scrap materials and debris caused by its operations, to the end that at all times the premises and site shall present a neat, orderly and workmanlike appearance. This is to be accomplished by having each floor broom swept at the end of each work day. Loading, cartage, hauling and dumping will be at the Contractor's expenses.

4.6.3 At the completion of the Work, the Contractor shall remove all its tools, construction equipment, machinery, temporary staging, formwork, shoring, bracing, protective enclosures, scaffolding, stairs, chutes, ramps, runways, hoisting equipment, elevators, derricks, cranes, etc. from the Project Site.

4.6.4 Should the Contractor not promptly and properly discharge its obligation relating to daily cleaning and final clean up, the College shall have the right to employ others and to charge the cost thereof to the Contractor after first having given the Contractor a three (3) working day written notice of such intent.

4.6.5 The Contractor's responsibilities in final clean up include:

- a. Removal of all debris and rubbish resulting from or relating to its work. Rubbish shall not be thrown from building openings above the ground floor unless contained within chutes;
- b. Removal of putty stains from glass and mirrors; wash and polish inside

and outside;

- c. Removal of marks, undesirable stains, fingerprints, other soil, dust or dirt from painted, decorated or stained woodwork, plaster or plasterboard, metal acoustic tile, ceilings, wall coverings, and equipment surfaces;
- d. Removal of spots, paint and soil from resilient, glaze and unglazed masonry and ceramic flooring and wall work;
- e. Removal of temporary floor protections, clean, wash or otherwise treat and/or polish, as directed, all finished floors;
- f. Vacuum all carpet areas;
- g. Cleanout all casework and wipe down countertop surfaces;
- h. Wipe down interior of elevator so it is free of finger prints and dust;
- i. Remove plastic and wipe down all light fixtures, receptacle and device cover plates;
- j. Polishing of all College furnished furniture;
- k. Clean exterior and interior metal surfaces, including doors and window frames and hardware, of oil stains, dust, dirt, paint and the like, polish where applicable and leave without fingerprints or blemishes;
- l. Wash down and clean exterior curtain wall metal and glazing;
- m. Wash down and clean roofing so to remove excess adhesive, dirt, and rust stains;
- n. Wash down of all exterior improvements including pavers, concrete, asphalt, benches, etc.; and
- o. Restoration of all landscaping, roadway and walkways to pre-existing condition. Damage to trees and plantings shall be repaired in the next planting season, and such shall be guaranteed for one year from date of repair and/or replanting at no additional cost to the College.

4.6.6 The Contractor must perform final cleaning prior to occupancy inspections by the governing authorities and another final clean prior to occupancy by the College.

4.6.7 All construction equipment, materials or supplies of any kind, character or description of value belonging to the Contractor which remain on the job site for more than thirty (30) days from the date of the Certificate of Final Acceptance and Completion issued by the College to the Contractor, shall become the absolute property of the College. It will be disposed of in any manner the College shall deem reasonable and proper.

4.6.8 The Contractor is responsible for final wall touchup just prior to College occupancy but after College furnished equipment and furniture move-in at no additional cost to the College. Touchup shall be performed for all imperfections and/or damaged caused by College move-in operations with equipment and furniture. Touchup shall include spackling and painting as required.

4.7 Interruptions to Existing Services

4.7.1 The Contractor shall make no utility shutdowns nor tie-ins which affect the operations of the utility system of any adjacent building or campus facility without requesting in writing the College's permission for shut down no less (14) calendar days prior to the proposed shut down. Utility shut downs shall occur at a time convenient to the College so as not to unreasonably interfere with its operations which means weekends, holidays, or after business hours. The Contractor is to include costs in the bid proposal for all premium hour costs related to these connections. Contractor shall assume the highest premium labor rate for this work in preparation of the bid.

4.7.2 When the existing fire alarm system requires shut down, The Contractor must provide (72) hours notice to the Construction Manager or the shutdown cannot be scheduled. The Contractor shall be responsible for providing a fire watch in accordance with the College's requirements during this shut down. Although the College will be responsible for scheduling the shut down through their service company (United Fire), the Contractor shall be responsible for all costs related to shut down.

4.8 Working Hours and Standby Personnel

4.8.1 Regular working hours shall be 7:00 a.m. to 3:30 p.m., Monday through Friday unless otherwise noted in the bid documents. Changes thereto may be granted with written approval of the Contracting Officer. Any work required to be performed after regular working hours or on Saturdays, Sundays, or Legal Holidays as may be reasonably required consistent with contractual obligations, shall be performed without additional expense to the College. Contractor shall obtain approval of the Contracting Officer for performance of work after regular working hours or on non-regular work days at least 24 hours prior to the commencement of overtime, unless such overtime work is caused by an emergency.

4.8.2 If, due to a trade agreement, standby personnel are required to supervise equipment installation, temporary lighting, temporary power, or for any other purpose, during normal working hours or overtime hours of other trades, the Contractor normally employing the trade required to provide such standby services, shall evaluate and include the costs thereof in its bid price and shall provide said services without additional charge to the College.

4.9 Record Documents

4.9.1 The Contractor shall maintain at the site for the College one copy of the Drawings, Specifications, Addenda, Bulletins, Architectural Supplemental Instructions, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These documents shall be delivered to the Construction Manager for submittal to the College upon completion of the Work as a record of the Work as constructed.

4.9.2 The Construction Manager will keep one set of DCA approved drawings on the project site at all times. These drawings shall be made available to the DCA Inspectors and the Contractor at any time during the progress of the work, upon their request. If the Contractor wishes to maintain a copy of these approved drawings, the cost of reproduction shall be the Contractors responsibility.

4.10 Shop Drawings, Product Data, and Samples

4.10.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work. The Contractor shall not use the Contract Drawings for submission of shop drawings. All shop drawings sizes shall be in multiples of 9" x 12" (e.g. 18" x 24"; 24 x 27"; 24" x 36" etc.) or as approved by the Architect/Engineer.

4.10.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

4.10.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.10.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Informational submittals upon which the Construction Manager and Architect are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Architect without action.

4.10.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect/Engineer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the Project submittal schedule approved by the Construction Manager and Architect, or in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work.

4.10.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the College, Construction Manager, and Architect, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents, and all adjacent work including other trades. The Architect/Engineer and Construction Manager are not responsible for such coordination during the submittal review process.

4.10.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed and approved by the Architect, unless directed otherwise by the College

4.10.8 The Contractor will be responsible to ensure that all subcontractors maintain a set of current Contract Documents and approved submittals in the field. The College will have the authority to stop work of a subcontractor if it is observed that the Work is being completed from outdated Contract Documents or unapproved submittals.

4.10.9 The Work shall be in accordance with approved submittals. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Construction Manager and Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof. The Architect's notation of "no exception taken" or "approved as noted" or similar language shall not be construed as authorizing any deviations from the Contract Documents. Should a deviation not be clearly identified in the submittal and the submittal is approved by the Architect and/or Engineer and the work is put in place, the Contractor will be responsible to remove, replace, and/or correct the work in place at no additional cost to the College to adhere to the contract documents.

4.10.10 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Construction Manager and Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

4.10.11 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's

responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the College and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The College and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the College and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. The Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

4.10.12 Submittals shall contain a Contractor's stamp of approval, signed and dated by the submitting Contractor, prior to submission to the Architect/Engineer. Such stamp of approval by the Contractor shall be confirmation that he has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information contained within such submittals. The Contractor shall also note in writing to the Architect/Engineer, all deviations to the Contract Documents. Submittals will not be reviewed by the Architect/Engineer unless they contain such a stamp containing the words "Reviewed and Approved" accompanied by the Contractor's signature and date.

4.10.13 The Architect's review is for conformance with the Design Concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Documents. No departures there from, are to be considered as authorizing extra work. The Contractor remains responsible for materials, dimensions, details and accuracy for confirming and correlating all quantities and dimensions, for selecting fabrication process for techniques of assembly, for performing this work in a safe manner, and of coordinating this work with that of all other trades.

4.10.14 The Contractor will have only two (2) opportunities to receive approval of any submittal without consequence. If an approval is not received by the second submission due to the Contractor's failure to adhere to the contract documents and/or Architect's/Engineer's review comments, the Contractor will be responsible for costs incurred by The College to review each submission thereafter until an approval is received.

4.10.15 Schedule delays that may result from the rejection of submittals for non-conformance to the contract documents are the responsibility of the Contractor to recover.

4.11 Coordination Drawings

4.11.1 Prior to installing service utilities or other piping, etc. through structural elements of the building, the Contractor shall prepare and submit, for approval of the Architect, accurate dimensioned Drawings indicating the positions and sizes of all sleeves and openings required to accommodate its work and installation of its piping, equipment, etc. and all with reference to the established dimensional grid of the Building. Such Drawings must be submitted in sufficient time to allow proper coordination with reinforcing steel Shop Drawings, openings in precast concrete members, and proper placing in the Field.

4.11.2 Before construction work commences and before submitting shop drawings for sleeves, piping, ductwork, etc., the Contractor shall require that the installers/ subcontractors for all trades submit Coordination Drawings.

4.11.3 The Contractor shall manage the process so that each trade/subcontractor provides all required information in a timely manner. Coordination Drawings may be completed on a phased basis so as not to delay the

overall project schedule. The CPM Schedule specified elsewhere shall be amended to include the submission of Coordination Drawings. The same shall demonstrate how the Contractor intends to integrate the submission of Coordination Drawings to suit the overall project schedule.

4.11.4 Coordination Drawings shall show the resolution of trade conflicts in congested areas prior to submission of shop drawings and actual installation. The Drawings shall coordinate the placement and location of ductwork, fittings, light fixtures, cable trays, fire alarm devices, sprinklers, air terminals, hangers, supports and other ceiling mounted items shown and specified with each other, and other building elements such as ceilings, structural work, case work, equipment, doors, manufacturer's recommended maintenance clearances, code required clearances and visibility sightlines (NEC, etc.), access doors and other contract work.

4.11.5 In public and occupied areas without scheduled finish ceilings, appearance is a major coordination factor. Reposition proposed locations of work after Coordination Drawing review. Provide adjustments to the exact size, location and offsets of ducts, pipes, and conduit to achieve reasonable appearance objectives. Provide these adjustments as part of the Contract or notify the Architect immediately as to why the adjustment cannot be made.

4.11.6 The medium and format of the Coordination Drawings shall be as follows:

- (1) The Contractor shall use CADD software to create the Coordination Drawings.
- (2) Each MEP Division trade shall be assigned a layer to create the detailing work of each section or division of the Specifications requiring coordination. The Contractor shall insure that the layer assigned to one trade cannot be modified by another trade, and that the final product clearly differentiates which trade is responsible for the respective information shown. The latter may occur through the use of colors or other distinct graphic methods.
- (3) The final product shall be in the form drawings drawn at a scale not less than 3/8 inch per foot for the entire building. Mechanical and Electrical equipment rooms shall be drawn separately at a scale not less than 1/2 inch per foot and be submitted with the drawings of the entire building. At conflicts between the trades, provide details, elevations, sections or three dimensional views of similar or larger scale as may be required to provide a clear three dimensional resolution of the conflict.

4.11.7 The Coordination Drawings shall be prepared as follows:

- (1) The Contractor shall prepare the base floor plan(s) in the medium chosen.
- (2) The HVAC trade installer shall prepare the first layer of the Coordination Drawings showing all ductwork, and all pertinent heating piping and equipment. This plan may be a copy of the required ductwork shop drawings.
- (3) The Contractor shall provide electronic or transparent copies to all the other trades/subcontractors.
- (4) The Plumbing, Fire Protection, Controls and other non-electrical trades shall show all their piping, equipment, valves, fittings and other specified appurtenances.
- (5) The Electrical, Fire Alarm, and other electrical trades shall show all systems and equipment, including transformers, panels, terminals, devices, detectors, lighting fixtures, cable trays, outlets, and conduits and raceways 1" or larger. Cable tray layout shall include appropriate clearances to motors, ballasts, and other sources of electromagnetic interference.

- (6) The Contractor shall review the Drawings and indicate areas of Architectural, Equipment, Structural and other conflicts and obstacles and coordinate locations of rated and exterior walls to assure their continuity and closure as specified. The Contractor determines that all work can be installed without interference. In the case of unresolved interference, the Contractor shall notify the Architect. The Architect will then suggest to the Contractor as to how to revise the Drawings to eliminate interference. The Contractor shall then have the trade(s) revise their respective Drawings to eliminate interference.
- (7) Fabrication and installation of work in a given bay or area shall not proceed until the Contractor has made all trades agree on the exact arrangements for each bay or area. If a given trade proceeds prior to resolving conflicts, then, if necessary, that trade shall change its work at no extra cost in order to permit the other trades to proceed with a coordinated installation. Coordination approval may be given by the Contractor for a bay or area only after site meetings involving all trades have occurred.
- (8) In the event of conflict areas without ductwork, each respective trade in conflict shall prepare coordination drawings showing the suggested final arrangements for review.

4.11.8 Coordination Drawings are intended for use by the respective trades during construction and shall not be construed as replacing either the shop drawings specified in the technical specifications or Record Drawings.

4.11.9 Submit Coordination Drawings for review in the same manner as specified for shop drawings. The Architect's review of Coordination Drawings shall not relieve the Contractor from his responsibilities for coordinating the work with the work of all trades involved on the Project. The Architect's review shall not authorize any extra cost, omission and/or deviation from the requirements of the Contract Documents. Any costs arising from errors and omissions in the Coordination Drawings shall be borne by the Contractor.

4.11.10 Provide three hard copies and electronic files (Adobe .pdf and CADD) of the Final Coordination Drawing at the completion of the work. All copies shall become the property of the College.

4.12 Demolition, Cutting and Patching

4.12.1 The Contractor shall be responsible for demolition, cutting, fitting, patching, and/or reconstruction required to complete the Work or to make its parts fit together properly regardless if not shown on the demolition plans or other contract drawings. All areas requiring cutting, fitting, patching, and/or reconstruction shall be restored to the condition existing prior to the demolition, cutting, fitting, patching, and/or reconstruction, unless otherwise required by the Contract Documents.

4.12.2 The Contractor shall make new Work fit existing work and/or existing conditions at Contractor's cost and expense. Changes in the Work attributable to varying field and/or existing conditions which represent a minor difference from those indicated on the drawings or can be reasonably predicted or expected to be encountered shall be provided and accomplished at no cost to the College.

4.12.3 Except as otherwise provided, Contractor shall do all cutting, drilling, removal, cleaning, servicing, repairing, reroofing, patching, re-hanging, and restoration that may be required in connection with the work. Contractor shall pay for the restoration of existing conditions and work of others damaged by his actions. Contractor shall be responsible for maintaining all existing warranties.

4.12.4 Replace, fit, patch and repair material and surfaces cut or damaged by methods and with materials required to restore surfaces to original conditions and in conformance with manufacturer's requirements in such a manner as not to void or compromise any warranties required or newly existing.

4.12.5 Prior to cutting and demolition work, the Contractor shall survey and locate utilities, structural elements and hazards using locator/detection equipment. Promptly submit a written report to the Architect

describing the nature and extent of any conflicts with the intended function or design of the work. Do not proceed with work until such conflicts are resolved.

4.12.6 All drilling and patching for expansion bolts, hangers and other supports shall be done only after approval of Architect.

4.13 Tests and Inspections

4.13.1 The College shall acquire and pay for material inspection or testing services. The Contractor shall contact the Construction Manager (72) hours in advance of all upcoming tests and inspections required.

4.13.2 The College will provide copies of inspection and test reports performed by the testing agency to the Contractor and code inspectors.

4.13.3 In the event that inspections or testing reveal a failure of the work to comply with the terms and conditions of the contract, the Contractor shall bear all costs incurred by the College for all re-inspection and tests by the testing agency.

4.14 Equipment and Material

4.14.1 The Contractor warrants to the Contracting Officer that all materials and equipment furnished under the Contract will be new, unless otherwise specified, and that all Work will be of good quality, free from faults, defects, and in conformance with Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected by the Contracting Officer or its authorized representatives. If required by the Architect/Engineer, the Construction Manager, or the Contracting Officer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of the other paragraphs contained herein.

4.14.2 Each Contractor shall furnish and deliver the necessary equipment and materials in ample quantities and as frequently as required to avoid delay in progress of the Work and shall store them so as not to cause interference with the orderly progress of the project.

4.14.3 The Contractor shall furnish and pay for all necessary transportation, storage, scaffolding, centering, forms, water, labor, tools, light and power mechanical appliances and all other means, materials and supplies for properly prosecuting the work under this Contract, unless expressly specified otherwise. The Contractor shall make arrangements to have representatives of its firm at the site to accept delivered materials. The College will not be held responsible for damage, theft, or disappearance of Contractor's property.

4.14.4 Pursuant to N.J.S.A. 52:33-2, only domestic materials shall be acquired or used for the Work, unless, upon the Contractor's written request to use non-domestic materials, the Contracting Officer shall determine that the use of a specific domestic material would be inconsistent with the public interest, or the cost would be unreasonable, or that domestic materials of the class or kind required are not mined, produced or manufactured, as the case may be, in the United States in commercial quantities and of a satisfactory quality,

4.14.5 Pursuant to N.J.S.A. 52:33-3, the Contractor and all subcontractors shall use only domestic materials in the performance of the Work; but if the Contracting Officer or other public officer authorized by law to make this Contract shall find that in respect to some particular domestic materials it is impracticable to make such requirement or that it would unreasonably increase the cost, an exception shall be noted in the Specifications as to that particular material, and a public record made by the College of the findings which justified the exception.

4.14.6 Pursuant to N.J.S.A. 52:33-4, if the Contracting Officer or other public officer having jurisdiction shall find, after written notice to the Contractor and subcontractor or materialmen (as applicable) and an opportunity

for the contractor to be heard, that in the performance of this Contract there has been a failure to comply with these "Buy American" provisions contained in the Contract, the public officer shall make public his finding, including therein the name of the Contractor obligated under such Contract, and no other contract for the construction, alteration or repair of any public work in this state shall be awarded to such contractor, or to any partnership, association or corporation associated or affiliated therewith, within a period of three years after such finding is made public.

4.14.7 No materials, equipment or supplies for the Work shall be purchased by the Contractor or any Subcontractor subject to any lien or encumbrance or other agreement by which an interest is retained by the Seller. The Contractor warrants, by signing its requisition for payment, that he has good and sufficient title to all such material, equipment and supplies used by him in the Work, free from all liens, claims or encumbrances.

4.14.8 The College shall not be limited to only standard colors for all materials and equipment. The Contractor shall include all costs in the bid proposal related to premium and/or custom colors for all materials and equipment.

4.15 Soil Borings

4.15.1 NOT USED

4.16 Protection of Contractor's Property

4.16.1 The Contractor shall adequately secure and protect its own tools, equipment, materials and supplies. The College assumes no liability for any damage, theft or negligent injury to the Contractor's property.

4.17 Patents

4.17.1 The Contractor shall hold and save the College and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the College, unless otherwise specifically stipulated in the Contract Documents.

4.17.2 License and/or Royalty Fees for the use of a process which is authorized by the College must be reasonable, and paid to the holder of the patent, or its authorized licensee, directly by the College and not by or through the Contractor.

4.17.3 If the Contractor uses any design, device or materials covered by letters, patent or copyright, he shall provide for such use by suitable agreement with the College of such patented or copyrighted design, device or material. It is mutually agreed and understood that, without exception, the Contract Prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or its Sureties shall indemnify and save harmless the College from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this Contract, and shall indemnify the College for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the Work or after the completion of the Work.

4.18 Right to Audit

4.18.1 The College reserves the right to audit the records of the Contractor in connection with all matters related to this contract. The Contractor agrees to maintain its records in accordance with generally accepted accounting principles, for a period of not less than five (5) years after receipt of final payment. "Generally Accepted Accounting Principles" is defined as follows: Accounting records must identify all labor and material, costs and expenses, whether they be direct or indirect. The identity must include at least the project number for direct expenses and/or account number for indirect expenses. All charges must be supported by appropriate documentation, including, but not limited

to cancelled checks. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

4.18.2 The Contractor shall develop, maintain and make available to the Contracting Officer on request such schedule of quantities and costs, progress schedules, daily construction reports, payrolls, reports, estimates, change orders, all original estimates, takeoffs, and other bidding documents, all Subcontractors and Supplier Contracts and changes, all records showing all costs and liabilities incurred or to be incurred in connection with the project including all Subcontractor and Supplier costs, all payment records and all records showing all costs incurred in labor and personnel of any kind, records and other data as the College may request concerning work performed or to be performed under this Contract.

4.18.3 The Contractor acknowledges and agrees that no claim for payment which is premised to any degree upon actual costs of the contractor shall be recognized by the College except and to the extent that such actual costs are substantiated by records required to be maintained under these provisions.

4.18.4 The Contractor acknowledges and agrees that the Contractor's obligation to establish, maintain and make available records and the College's right to audit as delineated herein, shall extend to actual costs incurred by subcontractors in performing work required under the contract or any supplemental agreement thereto. The contractor shall require in all subcontracts that the Subcontractor establish, maintain and make available to the College all records as defined and delineated herein relating to all work performed under the subcontractors including work performed by a Sub-Subcontractor.

4.19 Photographs

4.19.1 Photographs shall be taken on a daily basis representing work in progress. The photographs shall be submitted with each application for payment and shall be provided in both hard copy (two color copies) and digital formats (on CD). Photographs must be date stamped.

4.20 Daily Reports

4.20.1 The Contractor shall maintain and submit each daily report to the Construction Manager on the following day. Failure to provide the daily reports in a timely manner will cause the Construction Manager to withhold payment. Daily reports shall include, at a minimum, the following:

- a. daily weather conditions and any material impact on the Work caused thereby;
- b. the Contractor's personnel onsite;
- c. all Subcontractors working each day and the number of employees of each onsite;
- d. all equipment onsite;
- e. all materials and equipment delivered to the site;
- f. the Work accomplished each day;
- g. any material equipment failures or breakdowns;
- h. any accidents or unsafe conditions;
- i. any inspections performed

4.21 Warranties and Guarantees

4.21.1 Neither the final payment, nor any provision in the Contract Documents, nor partial or entire occupancy of the premises by the College shall constitute an acceptance of work not done in accordance with the Contract Documents. Nor shall it relieve the Contractor of liability with respect to any expressed or implied warranties or responsibility for faulty materials or workmanship. The College will give notice of observed defects with reasonable promptness.

4.21.2 In addition to guarantees otherwise specified in other sections of the Specifications, the Contractor and each individual Subcontractor shall guarantee and warrant, in writing, the work to be performed, and all materials to be furnished under this Contract against the defects in materials or workmanship and to pay for the value of repair of any

damage to other work resulting there from for a period of two (2) years from date of project acceptance. The form of this guarantee shall be a maintenance bond in the amount of 100% of the final contract amount. All guarantees, bonds, etc., required by the Specifications shall be in writing in requisite legal form, and delivered to the Contracting Officer at the time of submission of requisition for final payment. All Subcontractor's guarantees, bonds, etc., shall be underwritten by the Contractor, who shall obtain and deliver same to the Contracting Officer before the Work shall be deemed finished and accepted.

4.21.3 The Contractor shall, at its own expense and without cost to the College, within a reasonable time after receipt of written notice thereof, make good any defects in material or workmanship which may develop during stipulated guarantee periods, as well as any damage to other work caused by such defects or by their repairs. Any other defects in material or workmanship, not reasonably observable or discovered during the guarantee period, shall be repaired and/or replaced at the Contractor's expense and such shall be completed within a reasonable time after written notice is given to the Contractor.

4.21.4 It is anticipated that certain permanent equipment will have to be activated during construction of the project to support construction operations. This would particularly be the case with respect to elevators and those portions of the permanent electrical and heating/cooling systems which might be required to provide temporary power and heat/cooling for interior finish operations. Regardless of when equipment is delivered to the site and activated for use during construction, all equipment warranties must extend for the time periods required in these Specifications starting as of the date of Substantial Completion or final acceptance (whichever is the earliest) of the Project by the College. The Contractor shall include in their base bids all costs necessary to provide extended warranties as necessary for any equipment which may be activated prior to final acceptance of the College.

4.21.5 During the eleventh (11th) month after date of Substantial Completion, the Contractor shall meet with the College on a day mutually agreed upon and determine whether all conditions related to guarantees have been satisfied in accordance with the Contract. Should any defects appear at this time, they are to be remedied by the Contractor prior to the expiration of the General Guarantee. Any guarantees which are in effect for more than two (2) year after the date of Substantial Completion shall continue under conditions of the Contract. Nothing contained in this Paragraph shall release the Contractor from his obligations under his General Guarantees.

4.22 Indemnification

4.22.1 The Contractor shall assume all risk of and responsibility for, and agrees to indemnify, defend and save harmless the College, its employees, and its agents from and against, any and all claims, demands, suits, actions, recoveries, judgments and costs and expenses in connection therewith on account of the loss of life, property or injury or damage to the person, body or property of any person or persons whatsoever, resulting from the performance of the Project or through the negligence of the Contractor or through any improper or defective machinery, implements or appliances used by the Contractor in the project, or through any act or omission on the part of the Contractor or its agents, employees or servants, which shall arise from or result directly or indirectly from the work and/or materials supplied under this contract. This indemnification obligation is not limited by, but is in addition to, the insurance obligations contained in this agreement.

4.22.2 In any and all claims against the College, the Construction Manager, or the Architect/Engineer or any of their agents or employees by any employees of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Section 4.22 shall not be limited in any way as to the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under Worker's or Workman's Compensations Acts, Disability Benefit Acts, or other Employee Benefit Acts.

4.23 Contractor's Claims for Damages

4.23.1 Any claims made by a Contractor against the College for damages or extra costs are governed by and subject to the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1 et seq. as well as all the provisions in this contract.

4.23.2 Should any contractor or Architect/Engineer having, or who shall hereafter have, a contract with the College, by its own acts, errors or omissions, damage or unnecessarily delay the Work of the College, Architect/Engineer, or other contractors by not properly cooperating with them, or by not affording them reasonably sufficient opportunity or facility to perform Work as may be specified, by reason of which act, error or omission of the said contractor, the Architect/Engineer or any other contractor shall sustain damages, including delay damages, during the progress of the Work hereunder, then the injured contractor or Architect/Engineer shall have a right of action in court to recover such damages directly from the culpable party. The College shall not be liable to any contractor for any damages or extra costs caused by any acts or omissions as specified in this paragraph and the contractor's exclusive remedy shall be against the culpable party. . Nothing contained in this Paragraph shall be construed to relieve the culpable contractor or Architect/Engineer from any liability or damage sustained on account of such acts, errors or omissions.

4.23.3 Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the College, or through any act or omission of a subcontractor of any such contractor, or through any act or omission of the Architect/Engineer, the Contractor shall have no claims against the College for such damage, but shall have a right of action to recover such damages from the causing party or parties.

4.24 Layout, Dimensional Control and Verification, Surveyor's Certification

4.24.1 NOT USED

4.24.2 NOT USED

4.25 Project Sign

4.25.1 NOT USED

4.26 Use of Premises

4.26.1 The Contractor shall be limited to only areas under renovation and construction at all times. Contractor shall provide access to the College, Architect, Construction Manager, and other contractors performing work for the College.

4.26.2 Confine operations to areas within contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed. Should areas outside the contract limits be disturbed, it shall be the Contractor's responsibility to restore the area back to original conditions prior to disturbance.

4.26.3 Keep corridors and stairwells serving the premises clear at all times. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

4.26.4 Keep driveways and entrances serving the premises clear. Parking spaces outside of the construction area are to be available at all times to the College. Do not use these areas for parking or storage of materials.

4.26.5 The Contractor shall repair all damages caused by constructions operations. Take all precautions necessary to protect the building during the construction period.

4.27 Roads and Walkways

4.27.1 The Contractor shall be responsible for keeping all roadways, drives, parking areas, and walkways around the site free and clear of debris, gravel, mud, or any other site materials by insuring that all measures reasonably necessary are taken to prevent such materials from being deposited on such surfaces including, as may be appropriate, the cleaning of vehicle wheels, etc. prior to their leaving the construction site. Should such surface require cleaning, the

Contractor will clean these surfaces without additional cost to the College. The Contractor will be held accountable for any citations, fines, or penalties imposed on the College for failing to comply with local rules and regulations.

4.27.2 The Contractor shall obtain permission, in writing, from the Construction Manager before using any existing driveways or parking areas not specifically designated for such use in the Contract Documents for construction purposes. The Contractor shall maintain such driveways and areas in good condition during the construction period, and, at completion of the project, shall leave them in the same condition as at the start of the Work. Conditions before use should be carefully photographed or documented by the Contractor.

4.27.3 The Contractor shall be responsible for providing and maintaining unobstructed traffic lanes on the designated construction access routes either shown on the Contract Documents or reasonably required so as to perform the Work and shall provide and maintain all reasonably required safety devices. The Contractor shall provide the addition of materials, their grading and compaction, the removal of snow and debris so as to provide and maintain the general serviceable condition of the access roadbed, as well as pedestrian ways.

ARTICLE 5

SUBCONTRACTORS

5.1 Contractor-Subcontractor Relationship

5.1.1 The Contractor shall, within thirty (30) days after award of the Contract, notify the Contracting Officer through the Construction Manager, in writing, of the names of Subcontractors, other than those required to be listed in the Bid, proposed to perform the principal parts of the work and of such others as the Contracting Officer may direct, and shall not employ any Subcontractor without prior written approval of the Contracting Officer, or any that the Contracting Officer may, within a reasonable time, reject.

5.1.2 If the Contracting Officer has reasonable objection to any such proposed person or firm, the Contractor shall substitute another Subcontractor to which the Contracting Officer has no reasonable objection. Under no circumstances shall the College be obligated for additional cost due to such substitution.

5.1.3 The Contractor shall make no substitution for any Subcontractor, person or firm previously selected and approved, without written notification to the Contracting Officer and receipt of its written approval for such substitution.

5.1.4 The Contractor acknowledges its full responsibility to the College for the acts and omissions of its Subcontractors, and of persons and firms either directly or indirectly employed by them, equally to the extent that he is responsible for the acts and omissions of persons and firms directly or indirectly employed by him and the Contractor acknowledges he remains fully responsible for the proper performance of its Contract irrespective of whether Work is performed by its own forces or Subcontractors engaged by him.

5.1.5 Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor and the College.

5.1.6 By an appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the College. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreement with its Sub-subcontractors.

5.1.7 Contractor shall not grant to any Subcontractor terms more favorable than those extended to the Contractor by the College.

5.1.8 Contractor shall not permit its Subcontractor to subcontract work without the express written approval

of the Contracting Officer or designated representatives.

5.1.9 The Contractor and all Subcontractors, agree that, in the employment of both skilled and unskilled labor, preference shall be given to residents of the State of New Jersey, if such labor force is available.

5.1.10 Approval by the Contracting Officer or its authorized representatives of a Subcontractor or material supplier shall not relieve the Contractor or the Subcontractor or material supplier of the responsibility of complying with all provisions of the Contract Documents. The approval of a Subcontractor does not imply approval of any material, equipment or supplies.

5.1.11 Nothing contained in the Contract Documents shall require the Contractor to submit subcontractor change order proposals to the College for review if rejected by the Contractor.

ARTICLE 6

SPECIAL REQUIREMENTS

6.1 Construction Access Limitations

6.1.1 Contractor is only permitted in the designated construction areas and is not permitted to walk the building or to use building bathrooms. Contractor is to provide a temporary bathroom facility for its own use and placed at a location approved by the Construction Manager.

6.2 Equipment/Material Loading and Debris Removal

6.2.1 Material and equipment loading/unloading can only occur between the hours of 6:00 am and 8:00 am, Monday through Friday, and/or anytime on the weekends. No vehicles are permitted in the front or back of the buildings after 8:00 am, Monday through Friday.

6.2.2 Dumpsters cannot be located within 15' of a building when left overnight. The Contractor shall install dumpsters within this limit, but the dumpsters must be moved to meet this requirement before the Contractor leaves the site for the day.

6.2.3 All debris removal from the building will be done from a chute or equipment. Unauthorized debris removal will require immediate shut down of the operation.

6.3 Exterior Overhead Protection

6.3.1 NOT USED

6.4 Contractor and Subcontractor Identification

6.4.1 The Contractor shall employ an identification program for all workers onsite. Acceptable means of identification can be badges, company shirts, or identification clearly marked on hard hats. The Contractor must enforce this daily or it may result in workers being removed from the site.

6.5 Campus Dining Facilities

6.5.1 The campus dining facilities are off limits to the Contractor and subcontractors. The College does allow food carting services on campus for construction projects.

6.6 No Smoking

6.6.1 There is NO SMOKING permitted in existing buildings or in new construction areas. Smoking areas are to be within the site, but not immediately adjacent to buildings.

6.7 Contractor Parking

6.7.1 Contractor parking will only be allowed in general parking lot D-3 and in general parking lot across from the campus (near the tennis courts and ball fields). Parking at the buildings is prohibited.

6.7.2 The Contractor shall provide the necessary means to transport workers from the lots to the site if needed.

6.7.3 The Contractor shall provide garbage cans at all areas and be responsible for cleanup of these areas.

6.7.4 The Contractor shall be responsible for daily enforcement of these parking requirements. The College will provide parking passes to be distributed to all workers for the project. If the Contractor fails to enforce these parking requirements, the College will provide campus security at each parking lot on campus to prevent unauthorized parking of construction workers. The cost of these provisions will be deducted from the Contractors contract amount through a change order.

6.8 Live Site Web Camera System

6.8.1 NOT USED

6.9 Elevator Use for the College

6.9.1 NOT USED

6.10 Utility Survey Prior to Excavation and Cutting

6.10.1 Prior to saw cutting any concrete floor, Contractor shall infrared scan proposed areas to identify any utilities under or in the slab for safety purposes. Identified utilities are to be marked and reviewed with the Construction Manager prior to any saw cutting.

6.11 Building Enclosure

6.11.1 The Contractor shall maintain the buildings in a weather tight condition throughout the construction period. The Contractor shall take all precautions necessary to protect the building during the construction period. This shall include the following, but not limited to temporary exterior enclosures, temporary roofing, temporary doors / windows, etc. At no point will the existing building be left susceptible to weather conditions at the end of a workday regardless of the forecast. The use of temporary tarps for this requirement will not be permitted.

6.12 Commissioning

6.12.1 NOT USED

6.13 Hot Work Permits

6.13.1 The Contractor will be required to file hot work permits for all hot work performed in an existing College building. The Construction Manager will provide the necessary forms for use by the Contractor. All hot work will not be permitted until hot work permits are approved by the College.

6.14 Excess and Stored Soil

6.14.1 NOT USED

6.16 Concrete Slabs

6.16.1 NOT USED

ARTICLE 7

TEMPORARY FACILITIES, UTILITIES AND SERVICES

7.1 Field Offices

7.1.1 The Contractor shall provide and maintain during construction a suitable weather-tight insulated field office conveniently located for reception and continuous use and shall maintain therein a complete set of Contract Documents including plans, specifications, CPM network diagrams, change orders, logs and other details and correspondence.

7.1.2 The Contractor shall be responsible to provide utilities to the trailer including power, sanitary, and telecommunications. The College will make available phone and data service, but the Contractor must install all equipment and wiring. If the Contractor elects to use the College's phone system, the Contractor shall reimburse the College for phone charges.

7.1.3 The Contractor is responsible for filing and paying for all required permit applications with the Department of Community Affairs for the office trailers and utilities.

7.2 Storage Sheds, Tool Sheds, Shops, Employees Sheds

7.2.1 The Contractor shall provide and maintain, for its own use, and as each deems necessary, suitable and safe temporary storage, tool shops, and employee's sheds, for proper protection, storage work and shelter, respectively; maintain properly; and remove them at completion of Work. Rooms in the building may be used as shops and storerooms, with the approval of the Construction Manager. The Contractor making use of these areas shall be responsible for correcting defects and damage caused by such use and for keeping these areas clear and clean.

7.3 Site Logistics

7.3.1 The Contractor shall be responsible for providing for its own requirements within the contract limit lines. The Contractor shall locate these areas, to suit project requirements, with the Construction Manager's concurrence.

7.4 Temporary Toilet Facilities

7.4.1 The Contractor shall provide and pay for suitable temporary toilets, at an approved location on the site, prior to the start of any field work. They shall comply with State and Local laws. The Contractor will be responsible for maintenance, removal and relocation as described hereinafter.

7.4.2 Remove units from Site at completion of Work, when so directed.

7.4.3 Workmen are not to use the finished bathroom and toilet facilities in the project buildings. If the Construction Manager observes this to be a constant reoccurrence, offenders will be removed from site. In addition, the Contractor will be required to provide temporary facilities on each floor.

7.5 Temporary Water

7.5.1 The Contractor shall provide, protect and maintain an adequate valved water supplies for use on the project during the period of construction, either by means of the permanent water supply line, or by the installation of a temporary water supply line. All costs in providing water other than the cost of the water itself, will be borne by the Contractor.

7.5.2 Temporary water will be provided by the College at no charge to the Contractor, provided and to the extent it may be existing and available at the site immediately prior to commencement of and during construction. It is

the obligation of the Contractor requiring temporary facilities to investigate and make specific arrangements with the College for such facilities and to include in its proposal the cost of any additional facilities the Contractor may require for proper conduct of its Work.

7.5.3 The Contractor is responsible to protect all water lines from damage or freezing, be they permanent or temporary. Should water connections be made to an existing line, the Contractor shall provide a positive shut-off valve at its cost and expense.

7.6 Temporary Light and Power

7.6.1 The Contractor shall extend electrical service to the building or buildings from locations approved by the College or its authorized representative. Temporary electrical service shall be independent of the existing permanent service. Temporary light and power installations, wiring, and miscellaneous electrical hardware must meet the Electric Code. Electrical characteristics shall be provided to meet all temporary light and power reasonably required as herein and hereinafter specified. The Contractor shall provide the necessary distributing facilities and shall pay the cost of running temporary services from the nearest utility company power pole. All costs shall be included in its bid.

7.6.2 The College will provide electric to the Contractor for temporary use if existing service is available on campus. If service is not available and service needs to be provided by the local utility company, the Contractor is responsible for all costs billed by the local utility company.

7.6.3 The Contractor shall provide and pay for all maintenance, servicing, operating and supervision of the service and distribution facilities. The Contractor shall also connect, maintain and service any electrical equipment installed by the Contractor which may be necessary for maintaining heat/cooling whenever heat/cooling is required in the building whether from the temporary or permanent system.

7.6.4 The Contractor shall observe the requirements of the Federal Occupational Safety and Health Act of 1970 with regard to temporary light and power.

7.6.5 The Contractor shall install occupancy sensors on all temporary lighting.

7.7 Temporary Heat, Cooling and Dehumidification

7.7.1 The Contractor shall provide, protect, and maintain all measures to provide temporary heating, cooling, and/or dehumidification so that the work can progress without delay.

7.7.2 The Contractor shall not assume that the permanent building heating, cooling, and/or dehumidification system or any part thereof will be available for furnishing temporary heat, cooling, or dehumidification. The Contractor's base bid price shall therefore include the cost of all equipment necessary for providing temporary heat, cooling, and/or dehumidification as required under these specifications and guidelines required by material manufacturers.

7.7.3 All heating equipment shall be NFPA approved and connected to approved flues to the atmosphere. Gas cylinders within the building shall not exceed 100 lb. capacity, shall have Interstate Commerce Commission approval and shall be fitted with a permanent cap to protect the valve when not in use. Heaters shall be approved by a recognized testing laboratory and must be equipped with a positive shut-off safety valve. Cylinders and heaters shall stand at least 6 feet apart and be connected with two (2) braid neoprene hoses that will withstand 250 psi test pressure.

7.7.4 Storage of cylinders within the building will not be permitted at any time. Fire extinguishers shall be provided by the Contractor on each floor where heaters are used, and the area must be adequately ventilated.

7.7.5 If the permanent building heating, cooling, and/or dehumidification system or any part thereof is available for use to provide service during construction and use is approved by the Construction Manager, the system shall be maintained by the Contractor until turnover of the systems to the College. All systems shall be cleaned and

filters changed prior to acceptance by the College.

7.8 Temporary Enclosures and Partitions

7.8.1 Whenever necessary, in order to maintain proper temperatures or weather tight conditions for the prosecution of the Work, or for the protection thereof, the Contractor shall furnish and maintain temporary enclosures for all openings in exterior walls that are not enclosed with finishing materials. Temporary doors shall be provided at door openings.

7.8.2 The Contractor, at its expense, shall provide and maintain necessary temporary dust proof partitions around areas of work in any existing building or in new building areas as directed by the Construction Manager.

7.9 Temporary Utility Capping

7.9.1 Cap all incomplete lines, ducts, conduits, openings, etc., until ready for final connection, after which they shall be thoroughly cleaned and left unobstructed. Failure to perform this capping will result in the Contractor flushing and/or cleaning the material at the Contractors expense as directed by the Construction Manager.

7.10 Temporary Construction Fencing

7.10.1 The Contractor shall install 8' high construction fencing with privacy screening around the construction site or as detailed elsewhere in the Contract Documents. The construction fencing shall be installed with driven posts into the ground. Existing utilities are to be surveyed prior to the Work.

7.10.2 The Contractor shall establish all pedestrian and vehicle entrances/exits as required by the Contractor located by the Contractor prior to installing fence posts.

7.10.3 The Contractor shall maintain the construction fencing daily which includes replacement of damaged fencing and privacy screening when necessary or directed by the Construction Manager.

7.10.4 The site shall be secured at the end of each workday. Copies of padlock keys shall be provided to the Construction Manager and campus security.

7.11 Dumpsters

7.11.1 Dumpsters cannot be placed within 15' of the building at any time. Contractor shall make provisions in their bid for costs related to equipment or scaffolding for dumpster chutes.

ARTICLE 8

RELATIONSHIP BETWEEN THE CONTRACTOR AND OTHER COLLEGE CONTRACTORS

8.1 College's Right to Perform Work

8.1.1 The College may, and reserves the right to, enter upon the premises at any and all times during the progress of the Work, or cause others to do so for the purpose of installing any apparatus or carrying on any construction not included in these Specifications or for any other reasonable purpose.

8.1.2 The Contractor shall examine all Work or materials installed by other contractors, the installation of which may affect the Work in its Contract, and should the same be imperfect, incorrect or insecure, he shall notify the Contracting Officer immediately in order that the same be rectified.

8.2 Mutual Responsibility

8.2.1 The Contractor shall afford the Contracting Officer and other contractors under contract with the College reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work. Each contractor shall coordinate its Work with adjacent Work and with other trades, so that no portion of the Work is delayed or not properly undertaken due to such lack or failure of cooperation.

8.2.2 The Contractor shall lay out and install its Work at such time or times and in such manner as to facilitate the general progress of the Project.

8.2.3 The College shall not be liable for any damages suffered by any contractor by reason of another contractor's default, delinquency, or timing of performance; it being understood that the College does not assume responsibility for the acts or omission of any contractors.

8.2.4 Before completion of the Work contemplated herein, should it be deemed necessary by the College to do any Work whatsoever, in or about the building or structure, other than as provided for in the Contract Documents, the Contractor shall fully cooperate with such other individual or firm as the College may employ to do such Work, so that such additional Work may be performed without unreasonable interference. The Contractor shall afford said other individual or firm all reasonable facilities for doing such Work. Other than an Extension of Time should the work impact the critical path of the project, the Contractor shall make no claim for additional costs to the College, as a result of such Work as is contemplated herein.

8.2.5 The Contracting Officer, or its authorized representative, shall at all times have access to the Work whether it is in preparation or in progress, and the Contractor shall provide proper facilities for such access and for inspection. The Contracting Officer reserves the right, at its option, to employ the services of a professional consultant to evaluate any phase of the Work he may deem to be in the best interest of the College but no evaluation performed shall in any way relieve the Contractor of its responsibilities under the contract. The Contractor shall cooperate with the consultants and provide access to the Work and facilities for inspection. Should any portion of the Work or material be found deficient or defective, the Contractor will pay the applicable fees of such consultant and be responsible for replacing the deficient or defective Work as required by the provisions stated elsewhere herein.

8.2.6 Any costs caused by defective or ill-timed Work shall be borne by the Contractor.

8.2.7 If the Contractor should destroy, damage or disturb the Work of any other Contractor in or about the building or premises, the Contractor shall immediately either replace the destroyed Work and make good the damaged and disturbed Work to the satisfaction of the Construction Manager and the Contracting Officer, or shall reimburse the Contractor whose Work he has destroyed, damaged or disturbed for the expense of replacing such Work.

ARTICLE 9

TIME

9.1 Notice to Proceed

9.1.1 Contract time shall commence on the date of receipt by the Contractor of a written Notice to Proceed issued by the Contracting Officer. The Contractor agrees that contract administration will commence immediately and site work will commence no later than fourteen (14) calendar days after receipt of the Notice to Proceed. Once the proper contract documents are provided by the Contractor and contract award meeting conducted, the formal Contract will be executed by the College.

9.2 Adjustment of Contractor Completion Time

9.2.1 The Contract completion time or times will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any Contract Completion Date, the Contractor shall furnish such justification and supporting evidence that the College or the Construction Manager requires to evaluate the Contractor's request. The Contracting Officer shall then make its finding of fact and advise the Contractor in writing thereof. If the Contracting Officer finds that the Contractor is entitled to any extension of any Contract Completion Date under the provisions of this Contract, the determination as to the total number of days of the extension shall be based upon the currently approved computer-produced calendar-dated schedule and on all data relevant to the extension. Such data will be included in the next updating of the schedule.

9.2.2 Two (2) types of time extensions may be issued for this project as follows:

- (1) A total project time extension may be issued if delays which are determined to be beyond the control of the Contractor affect the main project critical path shown on the CPM Schedule thereby directly extending the final project completion date.
- (2) A concurrent project time extension may be issued in those instances where it is found that specific delays beyond the control of the Contractor would have affected the final project completion date were it not for overriding delays due to other causes. If a concurrent project time extension is issued, it will over that time which, according to the CPM Consultant's analysis, would have been lost due to the specific issues cited, if no other delays had occurred. A concurrent project time extension will also excuse the Contractor from responsibility for liquidated damages for the period of time extension.

9.2.3 The Contractor acknowledges and agrees that the evaluation of project delays and determinations regarding project time extension will be based upon the project CPM schedule and the following criteria:

- (1) Float time shown on the CPM schedule is not for the exclusive use of either the Contractor or the College. It is agreed that float time is available for use by all parties to facilitate the effective use of available resources and to minimize the impact of problems or Change Orders which may arise during construction. The Contractor specifically agrees that float time may be used by the College or its Representatives or Consultants in conjunction with their review activities or to resolve project problems. The Contractor agrees that there will be no basis for a project time extension as a result of any project problem, Change Order or delay which only results in the loss of available positive float on the project CPM schedule. The Contractor further agrees that there will be no basis for a claim for cost escalation for any activity which is completed on or before its initially required late end date as shown on the initial approved CPM schedule, regardless of the justifiability or any delaying factors which might have resulted in elimination of float which was originally available for the activity. If the Contractor refuses to perform work which is available to them, the Contracting Officer may, regardless of the float shown to be available for the work, consider

the Contractor to be in violation of the Contract Documents. In such instances, the Contracting Officer may, without prejudice to any right or remedy, and after giving the Contractor and its Surety three (3) working days written notice to forthwith commence and continue with the work with diligence and promptness, terminate the employment of the Contractor by the issuance of a written notice to that effect to the Contractor and its Surety at any time subsequent to three (3) working days thereafter, should they, or either of them, fail to comply with the directive of the original three (3) day notice mentioned above.

- (2) The Contractor agrees that no time extension will be granted for time lost due to normal seasonal weather conditions. In order to qualify for consideration for a time extension due to adverse weather conditions, it must be shown that the weather conditions during a given quarterly period (summer, fall, winter, spring) were more severe than the previous five year average for the project geographical area and, in addition, that these weather conditions critically impacted the final project completion date by delaying the performance of work on the main project critical path. If abnormal weather losses can be shown to have affected the project critical path, a non-time extension will be considered for that portion of the proven weather-related delays which exceeded the normal weather losses which should have been anticipated for the quarterly period in question.

No time extensions will be considered for any weather impacts which do not affect work on the main project critical path. .

- (3) In order for a given issue (i.e., delay, Change Order, etc.) to be considered as a basis for a total project time extension, it must meet both of the following criteria:
 - (a) It must be totally beyond the control of the Contractor and due to no direct or indirect fault of the Contractor; and
 - (b) It must result in a direct delay to work on the main project critical path.
- (4) The Contractor acknowledges and agrees that actual delays to activities which, according to the computer-produced calendar-dated schedule, do not directly affect the main project critical path do not have any effect on the Contract Completion Date or dates and will not be the basis for a change therein.
- (5) Concurrent delays are defined as two (2) or more delays or areas of work slippage which are totally independent of one another and which, if considered individually, would each affect the final project completion date according to the CPM schedule.

Where the College determines that concurrent delays exist, the Contractor acknowledges and agrees that the following criteria will be used to evaluate time extension:

- (a) If the current CPM schedule shows two (2) or more concurrent delays, with one (1) analyzed to be the responsibility of the College and the other analyzed to be the responsibility of the Contractor, a time extension will only be considered if the excusable delay affects the main project critical path and if this delay is shown by a greater amount than the other concurrent delays when their impacts are independently considered. In this event, a time extension will only be considered for that portion of time by which the excusable delay exceeds all concurrent non-College caused delays. For example, if an excusable impact delays the project by 100 days and concurrent Contract-caused slippage independently delays the final completion date by 90 days, a time extension will only be considered for a maximum of ten (10) days, provided the excusable delay is on the project critical path.

- (b) If the CPM Schedule shows concurrent delays with some excusable delays and some the fault of the Contractor, and if the Contractor-caused delays are analyzed to be the main determination impact to the main project critical path, then there will be no basis for a total project time extension regardless of the nature of the concurrent excusable delays. A concurrent time extension, however, may be considered for that portion of the total project slippage which is shown on the CPM schedule to be totally attributable to excusable delays.
- (c) If a time extension request is made for concurrent delays which did not affect the project critical path, this must be clearly stated in the Contractor's time extension request, and all CPM activities which are claimed to have been affected by the cited delay must be specifically identified with all applicable impact dates.

9.3 Delays - Damages Against the College - Limitations

9.3.1 The College shall have the right to defer the beginning or to suspend the whole or any part of the Work herein contracted to be done whenever, in the opinion of the Contracting Officer, it may be necessary or expedient for the College to do so. And if the Contractor be delayed in the completion of the Work by act, neglect or default of the College, or the Architect/Engineer, or of any other Contractor employed by the College upon the work, or by change orders in the work, or by strikes, lockouts, fire, unusual delay by common carriers, unavoidable casualties, or any case beyond the Contractor's control, or by any cause which the Contracting Officer shall decide to justify the delay, then for all such delays and suspensions the Contractor shall be allowed one day addition to the time herein stated for each and every day of such delay so caused in the completion of the work, the same to be determined by the Contracting Officer, and a similar allowance of extra time will be made for such other delays as the Contracting Officer may find to have been caused by the College. No such extension shall be made for any one or more of such delays unless within three (3) working days after the beginning of such delay a written request for additional time shall be filed with the Contracting Officer. .

9.3.2 The Contractor may not assert claims against the College for extra compensation by reason of any delays in its work resulting from acts or omissions of any third parties irrespective of extensions granted under the contract, including but not limited to delays caused by third parties such as the project architect, other contractors, utilities and governmental authorities.

9.3.3 The College shall only be required to pay additional compensation for delays caused by the College itself, and only to the extent required by N.J.S.A. 2A:58B-3 (delayed performance caused by the College's own negligence, bad faith, active interference or other tortuous conduct, but not for reasons contemplated by the parties and not for the negligence of others including others under contract with the College on the theory that such negligence should be imputed to the College). The College shall not be liable for any period of delay when there is a concurrent delay for which it is not responsible.

9.3.4 When the Contractor is entitled to extra compensation for delay under the contract and general conditions, it can only assert claims for extra costs at the job site, and may not assert claims for extra costs for home office expenses, home office overhead, lost profit or consequential losses. Any additional compensation under this paragraph shall also be subject to the provisions in the contract and general conditions regarding claims, and the provisions in the contract and general conditions regarding the maintenance and availability of cost records.

9.4 Liquidated Damages

9.4.1 In the event of the failure of the Contractor to complete the said work within the time stated in its proposal, the Contractor shall be liable to the College for EACH Substantial Completion milestone missed in the sum of twenty five hundred dollars (\$2,500.00) dollars for each and every calendar day that the said work shall be and remain uncompleted, which said sum shall be treated as liquidated damages and not a penalty, for the loss to the College of the use of premises in a completed state of construction, alteration or repair, as the case may be, and for added

administrative and inspection costs to the College on account of the delay; provided, however, that the liquidated damages provided for herein shall be in addition to other consequential losses or damages that the College may incur by reason of such delay, such as, but not limited to, added costs of the project and the cost of furnishing temporary services, if any. Any such items for which the Contractor is liable may be deducted by the College from any monies due or to become due to the Contractor.

9.4.2 It is hereby understood and mutually agreed by and between the Contractor and the College that the date of the beginning, the dates of required intermediate milestones, and the time for completion, as specified in the Contract of the work to be done hereunder are ESSENTIAL CONDITIONS of this Contract.

9.4.3 The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the College that the time for the completion of the work herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality. If the Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the Contracting Officer, then the Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay the College the amount specified in paragraph 9.4.1 above, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor may be held in default after the stipulated date in the Contract for completing the work.

9.4.4 The said amount is fixed and agreed upon by and between the Contractor and the College because of the impracticality and the extreme difficulty of fixing and ascertaining of the actual damages the College would in such event sustain, and said amount is agreed to be the amount of damages which the College would sustain and said amounts shall be retained from time to time by the College from current periodical estimates.

9.4.5 It is further agreed that Time is Of the Essence of each and every portion of this contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any Work the new time limit fixed by such extension should be of the essence of this Contract.

9.4.6 The Contractor shall not be charged with liquidated damages, or any excess cost when the College determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the College; provided further, that the Contractor shall not be charged with liquidated damages or any excess cost when the delay in the completion of the work is due:

- (1) To any preference, priority or allocation order duly issued by the Government.
- (2) To unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the College, acts of another Contractor in the performance of the Contract with the College which acts are contrary to the terms of such Contract, fires, floods, epidemics, quarantine restrictions, freight embargoes and severe weather; or
- (3) To any delays of Subcontractors or suppliers occasioned by any of the causes specified in sub-sections a. and b. of this article.

9.4.7 The Contractor shall, within three (3) working days from the beginning of such delay, unless the Contracting Officer shall grant a further period of time prior to the date of final settlement of the Contract, notify the College in writing, of the causes of the delay. The Contracting Officer shall first ascertain the facts and the extent of the delay and shall notify the Contractor within a reasonable time that good cause has been shown to warrant the granting of such extension. Should the Contractor fail to notify the College within the three (3) working days from the beginning of

such delay, the Contractor will not be entitled to an extension of time.

9.5 Contracting Officer's Right to Accelerate

9.5.1 The Contracting Officer may order and direct the Contractor to accelerate the Work at any particular place or places by increasing its forces, working overtime and/or on Saturdays, Sundays and holidays as may be required to complete certain Project areas and/or complete in advance of the Substantial Completion dates. The Cost of such acceleration efforts shall be paid by the College.

9.6 Substantial Completion

9.6.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the College can occupy or utilize the Work for its intended use.

9.6.2 When the Work or designated portion thereof is deemed substantially complete by the Architect and Construction Manager, the Architect will prepare a Certificate of Substantial Completion, which shall state the Architect's recommended date of Substantial Completion, together with the Architect's recommended division of responsibilities, if any, of the College, Contractor, Architect, and Construction Manager, for security, maintenance, heat, utilities, damage to the Work and insurance. The Architect, Construction Manager, and the College will jointly review the Certificate of Substantial Completion prepared by the Architect and agree on the date of Substantial Completion. Warranties required by the Contract Documents shall not commence on the date of Substantial Completion, but instead will commence upon final acceptance by the College.

9.6.3 The Certificate of Substantial Completion shall be submitted to the College and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the College shall make a partial payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

9.6.4 Upon final acceptance, a final inspection will be made by the materials manufacturer's representative, the Contractor, the Construction Manager, and the Architect. No payment will be authorized for work done until such inspection has been made, and all work is found to have been performed in accordance with the specifications and to the satisfaction of the College.

ARTICLE 10

PAYMENTS

10.1 Contractor Payments from the College

10.1.1 The College will make progress payments monthly as the work proceeds, or at more frequent intervals as approved by the College. The College will endeavor to approve payment twenty (20) calendar days after receipt of a fully executed application for payment with all required attachments as required in the Contract Documents, and provide to the Contractor a written statement of the amount withheld and the reason for withholding payment, before the end of the 20-day period,. The College shall pay the amount approved and due to the Contractor for each progress payment not more than 30 calendar days after the billing date.

10.1.2 The Contractor shall furnish schedule of values in accordance with the Contract requirements. The schedule of values, as approved, shall be used as a basis for the Contractor's estimates for progress payments. Approval by the Contracting Officer does not constitute acceptance of the allocability and allowability of costs to a specific element of work. The Contractor is cautioned that no payment requests shall be approved until the schedule of values has been approved in writing, by the Contracting Officer or its authorized representative.

10.1.3 In the preparation of applications for payment, the Contracting Officer, at its discretion, may authorize payment for material and equipment stored onsite. Material delivered to the Contractor at locations other than the site will not be approved for payment.

10.1.4 The College will not approve advance payments if requested by subcontractors or suppliers. Any advance payments required by subcontractors or suppliers shall be made by the Contractor and not passed onto the College.

10.1.5 In making such progress payments for Work, the College will retain 2% of the approved completed and stored to date amount and shall be deposited in an interest bearing account with a bank; and shall be released and paid to the contractor within 45 days of final acceptance of the project by the College as per PL. 2013, c. 147. If the Contractor elects to provide a retainage bond in the amount of 2% of the total contract value, the 2% retainage will not be retained by the College. All material and work covered by progress payments made shall thereupon become the sole property of the College, but this provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of all materials and work upon which payments have been made or the restoration of any damaged work, or as waiving the right of the College to require the fulfillment of all of the terms and conditions of the Contract.

10.1.6 If performance and payment bonds are required under this contract, the College shall pay to the Contractor the total premiums paid by the Contractor to obtain the bonds. This payment shall be paid at one time to the Contractor together with the first progress payment otherwise due after the Contractor has (1) furnished the bonds (including coinsurance and reinsurance agreements, when applicable), (2) furnished evidence of full payment to the surety company, and (3) submitted a request for such payment. The payment by the College of the bond premiums to the Contractor shall not be made as increments of the individual progress payments and shall not be in addition to the contract price.

10.1.7 Upon substantial completion and acceptance of all work, the amount due the Contractor under this contract, including retainage, shall be paid upon satisfactory completion, by the Contractor, of all contract close-out requirements, completion of a College audit on all contract values and payments, and after the Contractor shall have furnished the College with a release of claims against the College, arising by virtue of this contract, other than claims in stated amounts as may be specifically excepted by the Contractor from the release.

10.1.8 If, for any reason, the Contractor refuses final payment, the project shall be closed out by the College unilaterally processing a Final Acceptance Certificate. All residual funds will be held in escrow by the College until all claims of the College and all Contractors are satisfied.

10.1.9 In addition to other warranties required by provisions of the Contract and Specifications, the Contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the College, either upon incorporation into the construction or upon receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances. This provision shall not be construed as relieving the Contractor from sole responsibility for the care and protection of materials and Work upon which payments have been made, or the restoration of any damaged Work, or as a waiver by the College of its rights to require fulfillment of all terms of the Contract.

10.1.10 Approval of the Contractor's application for payment will constitute a representation by the Construction Manager to the Contracting Officer, based on its inspections at the site and data contained in the application for payment, that the Work has progressed to the point indicated; that, to the best of its knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents; and that the Contractor is entitled to payment in the amount certified. By approval of the application for payment, however the Construction Manager shall not thereby be deemed to represent that he has made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, or that he has reviewed the construction means, methods, techniques, sequences or procedures, or that he has made any examination to ascertain how and for what purpose the Contractor has used the monies previously paid on account of the Contract Sum.

10.1.11 Pursuant to N.J.S.A. 54:49-19, and notwithstanding any provision of the law to the contrary, whenever any taxpayer, partnership or S corporation under contract to provide goods or services or construction projects to the State of New Jersey or its agencies or instrumentalities, including the legislative and judicial branches of State government, is entitled to payment for those goods or services at the same time a taxpayer, partner or shareholder of that entity is indebted for any State tax, the Director of the Division of Taxation shall seek to setoff that taxpayer's or shareholder's share of the payment due the taxpayer, partnership, or S corporation. The amount set off shall not allow for the deduction of any expenses or other deductions which might be attributable to the taxpayer, partner or shareholder subject to set-off under this act.

10.1.12 The Director of the Division of Taxation shall give notice to the set-off to the taxpayer and provide an opportunity for a hearing within thirty (30) days of such notice under the procedures for protests established under R.S. 54:49-18. No requests for conference, protest, or subsequent appeal to the Tax Court from any protest under this section shall stay the collection of the indebtedness. Interest that may be payable by the State, pursuant to P.L. 1987, c.184 (c.52:32-32 et seq.), to the taxpayer shall be stayed.

10.1.13 The Contractor shall pay each Subcontractor, no later than seven calendar days after receipt of payment from the College the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

10.1.14 The Contracting Officer will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the College, Construction Manager and Architect on account of portions of the Work done by such Subcontractor.

10.1.15 The Contracting Officer has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the College to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven calendar days, the College shall have the right to contact Subcontractors to ascertain whether they have been properly paid. The College nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

10.1.16 The Contracting Officer or its authorized representatives may withhold payments in whole or in part, to the extent reasonably necessary to protect the College, if in the Contracting Officer's or its authorized representatives opinion the representations to the College required by the Contract Documents cannot be made. If the

Contracting Officer or its authorized representatives are unable to certify payment in the amount of the application for payment, the Construction Manager will notify the Contractor and The College. If the Contractor, Construction Manager and Architect cannot agree on a revised amount, the Contracting Officer or its authorized representatives will promptly issue an application for payment for the amount for which the Contracting Officer or its authorized representatives are able to make such representations to the College. The Contracting Officer or its authorized representatives may also withhold payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a payment previously issued, to such extent as may be necessary in the Contractor Officer's or authorized representatives opinion to protect the College from loss for which the Contractor is responsible, including loss resulting from the acts and omissions because of:

- (1) defective Work not remedied;
- (2) third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the College is provided by the Contractor;
- (3) failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- (4) reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- (5) damage to the College or a separate contractor;
- (6) reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- (7) repeated failure to carry out the Work in accordance with the Contract Documents.

When the above reasons for withholding certification are removed, payments will be made for amounts previously withheld.

10.1.17 The Contracting Officer or its authorized representatives may reduce line items previously approved and paid should it be found that the work represented as complete is rejected or not complete. Held retainage will not serve for these discoveries.

10.1.18 If the Contracting Officer withholds certification for payment under this article, the College may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered.

10.1.19 If closeout requirements are not delivered within the time specified by this contract or are deficient upon delivery, the Contracting Officer, at its discretion, will withhold from each invoice a percentage (in addition to any other retainage required by the Contract) or the contract price in accordance with the table below. The withholding of any sums pursuant to this Article shall not be construed as, or constitute in any manner, a waiver by the College of the Contractor's obligation to furnish the data required under this contract. In the event the Contractor fails to furnish these items, the College shall have those rights and remedies provided by law and pursuant to this contract in addition to, and not in lieu of, the sums withheld in accordance with this Article.

<u>When total contract amount is</u>	<u>Percentage to be withheld is</u>
Less than \$250,000.....	5% of total contract
\$250,000 to \$1,000,000.....	2% of total contract
Over \$1,000,000.....	1/2% of total contract

10.2 Final Application for Payment

10.2.1 Upon completion of the Work, the Contractor shall forward to the Contracting Officer a written notice that the Work is ready for final inspection and acceptance and shall also forward to the Contracting Officer a final Contractor's Application for Payment. Upon receipt, the Contracting Officer and its authorized representatives will evaluate the completion of Work of the Contractor and then forward the notice and Application, with

recommendations, to the Architect who will promptly make such inspection. When the Architect, finds the Work acceptable under the Contract Documents and the Contract fully performed, the Contracting Officer will promptly issue a final application for payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Application for Payment is due and payable.

10.2.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Contracting Officer (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the College or the College's property might be responsible or encumbered (less amounts withheld by the College) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the College, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the College, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of any and all claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the College.

10.3 Interest

10.3.1 Interest shall be paid on the amount due the Contractor pursuant to a properly executed State invoice if a required payment is not made by the College by 30 calendar days after the billing date as provided in Section 10.1.1 above...

10.3.2 Interest on amounts due shall be paid to the Contractor for the period beginning on the day after the required payment date and ending on the date on which the check for payment is drawn. The interest shall be paid at a rate equal to the prime rate plus 1%, pursuant to the New Jersey Prompt Payment Act, N.J.S.A. 2A:30A-2(c).

10.3.3 No interest charge as required by this provision shall become a debt of the State until it exceeds \$5.00.

10.3.4 Interest may be paid by separate payment to the Contractor, but shall be paid within thirty (30) calendar days of payment of the original invoice.

10.3.5 The State Treasurer shall have the right to waive the interest payment for delinquencies due to circumstances beyond the control of the Contracting Officer (or other State or College representatives involved in the processing of contractor invoices) including but not limited to strikes and natural disasters.,

10.3.6 Nothing in this provision nor the New Jersey Prompt Payment Act shall be construed as permitting the accrual of prejudgment interest in the case of a disputed contract for which a notice of claim has been filed pursuant to N.J.S.A. 59:13-1 et reg., except as provided in N.J.S.A. 59:13-8.

10.4 Payment Disputes - Claims Against the College

10.4.1 All claims by the Contractor against the College arising under this Contract shall be governed by the N.J. Contractual Liability Act, N.J.S.A. 59:13-1 et seq., including the notice of claims provisions therein (see N.J.S.A. 59:13-5).

10.4.2 Where a timely notice of claim has been submitted to the College by the Contractor pursuant to N.J.S.A. 59:13-5, the College and the Contractor agree to submit the dispute to a mutually agreed upon mediator for mediation as provided by N.J.S.A. 2A:23C-2, with the mediator's fees to be shared equally among the mediation parties. This alternative dispute resolution process is adopted by the College and the Contractor in compliance with the N.J. Prompt Payment Act, N.J.S.A. 2A:30A-2(f).

ARTICLE 11

UNCOVERING AND CONSTRUCTION OF WORK

11.1 Uncovering of Work

11.1.1 If any portion of the Work is covered prior to inspection conducted by the Contracting Officer, the Architect/Engineer, governing authorities, material testing agencies, or the Construction Manager, especially work specifically required by the Contract Documents to be inspected, it shall be uncovered for observation. Uncovering and replacement of covering shall be at the installation Contractor's expense. The Contractor is obligated to advise the Contracting Officer or the Construction Manager of all work scheduled to be covered which is reasonably subject to prior inspection before actual covering.

11.1.2 If any other portion of the Work (not specifically required to be inspected) has been covered, which the Contracting Officer, the Architect/Engineer, or the Construction Manager did not make a request to observe prior to being covered, a request may subsequently be made to inspect such Work, and it shall be uncovered by the installation Contractor. If such Work is found to be in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate change order, be reimbursed by the College. If the work is found not to be in accordance with the Contract Documents, the Contractor shall pay all associated costs, unless it is found that this condition was caused by the College, in which event the Contracting Officer shall be responsible for the payment of such costs.

11.2 Correction of Work

11.2.1 The Contractor shall promptly correct all Work rejected by the Contracting Officer, the Architect/Engineer, governing authorities, material testing agencies, or the Construction Manager as defective or as failing to conform to the Contract Documents, whether observed before or after Final Acceptance and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including but not limited to, the Architect/Engineer's additional services, if any.

11.2.2 The Contractor shall remove from the Site all portions of the Work which are defective or nonconforming and which have not been corrected unless removal is waived by the Contracting Officer.

11.2.3 If the Contractor fails to correct defective or non-conforming Work in a timely manner, the Contracting Officer may make arrangements for such correction by others and charge the cost of so doing to the responsible Contractor and/or its Sureties.

11.2.4 If the Contractor does not proceed with the correction of such defective or nonconforming work within a reasonable time, fixed by written notice from the Contracting Officer, the Architect/Engineer, governing authorities, material testing agencies, or the Construction Manager, the Contracting Officer may remove it and may store the materials or equipment at the expense of the Contractor. If the Contractor does not pay for the cost of such removal and storage within ten (10) working days thereafter, the Contracting Officer may upon ten (10) working days additional written notice sell such material and equipment at auction or at private sale and shall account for the net proceeds thereof, after deducting all of the costs which are the responsibility of the Contractor, including compensation for the Architect/Engineer's additional services, if any. If such proceeds of sale do not cover all costs which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate credit Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor and/or its Surety shall pay the difference to the College.

11.2.5 The Contractor shall also be responsible for the cost of making good all Work destroyed or damaged by such correction or removal.

11.2.6 Nothing contained herein shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents.

11.3 Acceptance of Defective or Nonconforming Work

11.3.1 If the College determines that the best interests of the College will be served by accepting defective or nonconforming Work, the College may do so instead of requiring its removal and correction. In such instance, a Change Order will be issued to reflect an appropriate and equitable reduction in the Contract Sum. Such adjustment shall be effected regardless of Final Payment having been previously made, and the Contractor and/or its Surety shall be responsible for promptly providing any funds due the College as a result thereof.

ARTICLE 12

PROTECTION OF PERSONS AND PROPERTY

12.1 Safety Precautions and Programs

12.1.1 The Contractor shall submit a site specific safety program to the Construction Manager within (21) calendar days of the issuance of the Notice to Proceed. The program, which shall include details commensurate with the Work to be performed, must clearly describe the Contractor's commitments for meeting its obligations to provide a safe and healthy construction site for all construction workers, and its obligations to protect vendors, and visitors. The program shall reference OSHA standards, and any other rules or regulations applicable to the Project, including state and local requirements.

12.1.2 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall designate a responsible member of its organization at the Site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent, unless otherwise designated by the Contractor, in writing, to the College and the Construction Manager. In addition, the Contractor at its cost shall have an independent safety inspection firm perform inspections on a bi-weekly basis. All inspection reports and safety violations shall be provided to the Construction Manager.

12.2 Safety of Persons and Property

12.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

- a. Every employee on the Work and all other persons who may be affected thereby;
- b. All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of its Subcontractors or Sub-subcontractors; and
- c. Other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

12.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

12.2.3 All workers on the project site are to wear hard hats and safety glasses, no exceptions. A worker will be given one (1) warning for a violation of this requirement. Should the same worker be observed again violating this requirement, the Contractor will be required to remove the worker from site permanently.

12.2.4 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including rails, night lights, the posting of danger signs and other warnings against hazards, promulgating safety regulations, and other means of protection against accidental injury, or damage to persons and property.

12.2.5 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

12.2.6 No Contractor shall load or permit any part of the Work to be loaded so as to endanger its safety.

12.2.7 The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, any of its Subcontractors, Sub-subcontractors, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable and for which the Contractor is responsible, except damage or loss attributable to the acts or omissions of the College or Architect/Engineer, or anyone directly or indirectly employed by either of them or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to its obligations stated elsewhere herein.

12.3 Emergencies

12.3.1 In any emergency affecting the safety of persons or property, the Contractor shall act with diligence, at its discretion, to prevent threatening injury, damage or loss. In such case, he shall immediately notify the Contracting Officer, through the Construction Manager, of the action taken.

ARTICLE 13

INSURANCE AND INDEMNITY

13.1 Contractor Insurance Requirements

13.1.1 The Contractor shall secure and maintain in force for the term of the Contract, insurance coverage provided herein. All insurance coverage is subject to the approval of the College and shall be issued by an insurance company authorized to do business in the State of New Jersey and which maintains an A.M. Best rating of A- (VII) or better. The Contractor shall provide the College with current Certificates of Insurance for all coverage and renewals thereof which must contain the provision that the insurance provided in the certificate shall not be canceled for any reason except after thirty (30) days written notice to the College and ten (10) days written notice for non-payment of premium. All insurance required herein shall contain a waiver of subrogation in favor of the College. The CGL insurance required herein, including independent contractors, products/completed operations, contractual and professional liabilities, shall name Ramapo College of New Jersey, the State of New Jersey, the New Jersey Educational Facilities Authority, the Architect/Engineer and Construction Manager as additionally insured.

13.1.2 Commercial General Liability insurance written on an occurrence form including independent contractor liability, products/completed operations liability, contractual liability, covering but not limited to the liability assumed under the indemnification provisions of this contract. Coverage for bodily injury and property damage claims arising out of the professional acts of the general contractor and subcontractors shall also be included. The policy shall not include any endorsement that restricts or reduces coverage as provided by the ISO CG0001 form without the approval of the College. The minimum limits of liability shall not be less than a combined single limit of two million dollars (\$2,000,000) per occurrence, two million dollars (\$2,000,000) general aggregate, two million dollars (\$2,000,000) product/completed operations aggregate. A "per project endorsement" shall be included, so that the general aggregate limit applies separately to the project that is the subject of this contract.

13.1.3 Comprehensive Automobile Liability covering owned, non-owned, and hired vehicles. The limits of liability shall not be less than a combined single limit of one million dollars (\$1,000,000) per occurrence.

13.1.4 Worker's Compensation Insurance applicable to the laws of the State of New Jersey and other State or Federal jurisdiction required to protect the employees of the Contractor and any Subcontractor who will be engaged in the performance of this Contract. The certificate must so indicate that no proprietor, partner, executive officer or member is excluded. This insurance shall include Employers' Liability Protection with a limit of liability not less than one million dollars (\$1,000,000) bodily injury, each occurrence, one million dollars (\$1,000,000) disease, each employee, and one million dollars (\$1,000,000) disease, aggregate limit. Including the employer's liability insurance under the umbrella insurance can satisfy the limit requirements.

13.1.5 The Contractor shall obtain and maintain a separate Colleges and Contractor's Protective Liability Insurance Policy for the same limits of liability as specified for the Commercial General Liability Insurance in the name of the College, the State of New Jersey and the New Jersey Educational Facilities Authority. The Architect/Engineer, and the Construction Manager are to be named as additional insured. The policy shall be maintained in force for the term of the Project or one year, whichever is longer.

13.1.6 Excess Liability, umbrella insurance form, applying excess of primary to the commercial general liability, commercial automobile liability and employer's liability insurance shall be provided with minimum limits of five million dollars (\$5,000,000) per occurrence, five million dollars (\$5,000,000) general aggregate, and five million dollars (\$5,000,000) products/completed operations.

13.1.7 The contractor shall require all subcontractors to comply with all of the insurance requirements described above. It is a contractor option to determine the amount of liability it will require its subcontractors to carry. The contractor shall be responsible for obtaining certificates of insurance for all coverage and renewals thereof for each subcontractor prior to the subcontractor's beginning work on the project. The contractor shall provide copies of all subcontractor certificates of insurance to the College upon request.

13.1.8 The Contractor shall submit a separate declaration from the commercial general liability and excess umbrella insurance carriers specifically confirming that there are no exclusions within each policy for roofing replacement work.

13.2 Insurance to be carried by The College

13.2.1 The College shall provide insurance protection in the form of a Builders Risk Insurance or similar Policy upon the structure for which the Work on this Contract is to be done. The structure will be insured for 100% of the insurable replacement value thereof including materials, owned by the College, in place or to be used as part of the permanent construction including surplus materials.

13.2.2 This insurance shall not protect against damage or loss to any of the Contractor's or Subcontractor's tools, equipment, scaffolding, staging towers or forms, Contractor's materials and sheds or other temporary structures erected for used by the Contractor or Subcontractors. It is understood that the Contractor will at their own expense, carry all insurance which may be required to provide the necessary protection against such loss or damage herein described which insurance shall contain a waiver of any right of subrogation against the College.

13.2.3 The insurance procured by the College under this paragraph may provide for a deductible. The Contractor shall assume the responsibility for any deductible for any builder's risk loss it may make claim for under this policy.

13.2.4 The Contractor shall immediately notify the College, in writing and take any other appropriate steps as may be required under the standard Builder's Risk Insurance Policy in effect in the event of any loss. Prior to the acceptance of the building by the College, the Contractor shall, at the College's option, replace and repair the damaged Work as originally provided in the drawings and specifications at no additional compensation to that provided in the original contract.

13.2.5 All losses will be adjusted with, and payable to, the College.

13.2.6 Contractor shall not include any cost for Builders Risk insurance premiums as described herein. However, this provision shall not relieve the Contractor from their obligation to complete, according to plans and specifications, the project covered by the contract, and the Contractor and their Surety shall be obligated to full performance of the Contractor's undertaking.

ARTICLE 14

CHANGES IN THE WORK

14.1 Changes to Contract

14.1.1 The Contracting Officer may, at any time, by written order designated or indicated to be a change order, make any change in the work within the general scope of the contract, including but not limited to, changes:

- (1) In the Contract Documents;
- (2) In the method or manner of performance of the work;
- (3) In the College furnished facilities, equipment, materials, services, or site;
or
- (4) Directing acceleration in the performance of the work.

14.2 Processing of Contractor Requests for Equitable Adjustment

14.2.1 Notwithstanding any other Article of this contract, any time extensions for changes in the work depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The contract modification making such time extension will provide for an extension of contract completion date only for those specific elements so delayed and will not alter the contract completion dates for other portions of the work. This contract modification may further provide for an equitable readjustment of liquidated damages pursuant to the new completion schedule. The Contractor will not be permitted to submit a change order proposal with any language reserving the Contractor's right to submit additional costs or time impacts related to a change. Such language will void the change order proposal and will be returned to the Contractor without review.

14.2.2 The Contractor, in connection with any request for an equitable adjustment, shall furnish a price breakdown, itemized as required by the College. Unless otherwise directed, the breakdown shall cover all work involved in the change whether such work was deleted, added or changed. The breakdown shall be in sufficient detail to permit an analysis of all material, labor, equipment, indirect, and subcontractor costs. Any amount proposed for subcontracts shall be supported by a similar price breakdown. In addition, if the request includes a time extension, a justification shall also be furnished. The request, together with the price breakdown and time extension justification, shall be furnished by the date specified in the Contract Documents. It is the Contractor's responsibility to include all direct and indirect work related to a change in the request. If the Contractor fails to identify work in the request that is later discovered as a result of the change, the work will be completed at no additional cost to the College.

14.2.3 If a change order proposal is submitted without a schedule extension request and documentation justifying the request, the College will consider the change in work to not have a schedule impact. The Contractor will not have a right to request adjustment of the Contract time after a change order has been executed by the College for the work.

14.2.4 If a change is submitted for work performed without prior notification to the College, the College is not responsible for the cost of the change since the avoidance of such costs was not afforded to the College.

14.2.5 Contractor change order requests are to be submitted on the provided form for approval by the College and shall include the following components:

1. Direct Materials – Direct material costs shall consist of actual cost of materials purchased by the Contractor. Contractors are to list all materials with quantities and unit prices along with bill of sale from the applicable vendor.

2. Direct Equipment – Rental and operating costs for equipment only, either rented or owned, by the Contractor. The equipment shall be listed with quantity of hours and hourly rate. For verification of the rate charged, the Contractor shall furnish a comparable rental rate from a vendor should the equipment be owned by the Contractor. Costs for operation will only be approved for actual operation for the approved change in work regardless on the time the equipment is onsite.
3. Direct Labor – The term direct labor shall include working foremen (non-working foremen are considered overhead), journeymen, apprentices, equipment operators, and/or laborers directly assigned to the approved change in work by the Contractor. The total hourly rate shall be calculated and include only the following:
 - a. Base hourly rate consistent with the requirements of the New Jersey Prevailing Wage Act law or local union hourly rates if the Contractor is union. If union, the Contractor must provide the local union bi-laws for confirmation of the hourly rate.
 - b. Labor burden shall only include social security and Medicare taxes, federal unemployment taxes, state unemployment taxes, and workman's compensation.
 - c. Fringe costs consistent with the requirements of the New Jersey Prevailing Wage Act law or local union. Fringe costs shall only include, if applicable, welfare, pension, annuity, and education/training benefits. Costs such as travel, small tools, vacation, etc. are considered overhead costs. If union, the Contractor must provide the local union bi-laws for confirmation of fringe costs.
4. Indirect Costs – Included are costs which are neither direct construction material, equipment, and labor costs. Allowable indirect costs are for engineering if applicable, premium freight charges if approved by the College, and permits. No other indirect costs will be considered. Copies of invoices are to be provided for billing verification.
5. Contractor Markup - A markup of 10% shall be applied to the subtotal of items 1 through 4. This markup shall cover profit and overhead/general condition costs such as dumpsters, office personnel, project managers, field superintendents, field office and consumables, mailing, misc. reproduction, safety, temporary utilities, company vehicles and mileage, etc. related to self performed work. Costs not defined in items 1 through 5 are considered overhead. The 10% markup shall apply to deleted work as well.
6. Subcontracted Work – All subcontracted work shall be itemized similar to items 1 through 4 above. A markup of 10% shall be applied to the work performed by the Subcontractor. This markup shall cover profit, insurances, bonding, and overhead costs such as dumpsters, office personnel, project managers, field superintendents, field office and consumables, mailing, misc. reproduction, safety, temporary utilities, company vehicles and mileage, etc. related to self performed work. Costs not defined in items 1 through 4 are considered overhead. The 10% markup shall apply to deleted work as well. The Contractor agrees to incorporate this provision in each of its subcontracts.
7. Contractor Markup on Subcontracted Work – A markup of 5% shall be applied to the subtotal of subcontracted work only. This markup shall cover profit, insurances, bonding, and overhead/general condition costs related to subcontracted work such as dumpsters, office personnel, project managers, field superintendents, field office and consumables, mailing, misc. reproduction, safety, temporary utilities, and company vehicles and mileage, etc. The 5% markup shall apply to deleted work as well.

When more than one tier of subcontracts exists, for the purpose of markups, they shall be treated as one subcontract.

14.2.6 Where material and/or equipment is made obsolete and was not made part of the construction as a result of a change, the College can either take possession of the excess material and/or equipment or direct the Contractor to take possession. If the College elects to take possession of the excess material and/or equipment, the

College will pay for the material and/or equipment costs related to the change. If the College refuses to take possession of the excess material and/or equipment, the College will be entitled to a credit for the excess material and/or equipment returned to the Contractor and will not be responsible for any restocking charges.

14.2.7 The Contractor must review submitted subcontractor change order proposals prior to submission to the College and make any corrections necessary. When the Contractor fails to review change order proposals and submits the proposals to the College with obvious accounting errors or if the work is clearly defined in the Contract Documents, the Contractor will be responsible for all costs incurred by the College for review time by its professionals. Submission of a change order proposal that contains falsified information, altered documents, or identifies costs in excess of the actual cost shall constitute a breach of this Contract.

14.2.8 In the instance of a change resulting in a deduction in the contract amount, the amount shall be based on actual cost of such Work and not the amount represented in the contractor's schedule of values.

14.2.9 At no time will the College or designated representatives review submitted change order proposals with the Contractor's subcontractors. All change order proposals will be reviewed and negotiated between the College or Construction Manager and the Contractor. It is the responsibility of the Contractor to review and negotiate subcontractor change order proposals without the presence of the College or Construction Manager.

14.2.10 Upon completion of work as directed in a construction change directive, the Contractor has fourteen (14) calendar days to submit a change order proposal. Failure to submit a change order proposal within this time frame waives the Contractor's right to recover costs incurred.

14.3 Remedies for Disputed Change Order Proposals

14.3.1 When the Contractor and the College cannot reach an agreement on the cost of a change, the College has the right to direct the Contractor to proceed with the change in work on a "Time and Material" basis not to exceed the Contractor's proposed cost. The Contractor agrees that all work related to the change will be completed on this basis and the Contractor is not entitled to any costs above and beyond the proposed amount.

14.3.2 When the Contractor and Construction Manager disagree on a Contractor claimed contract document error and/or omission, the Contractor can request a hearing with the Contracting Officer. However, the Work must proceed as directed by the College without any impact to the project schedule. Upon such request, the Contracting Officer has thirty (30) calendar days to schedule the hearing. At this hearing, the Contractor shall provide sufficient documentation to support the Contractor's position in order for the Contracting Officer to render a decision. The Contracting Officer has fourteen (14) calendar days to render a decision. The Contracting Officer's decision is final.

14.3.3 The Contractor's refusal to perform the Work related to a change or a directive shall constitute a breach of this Contract.

ARTICLE 15

ASSIGNMENT OF ANTITRUST CLAIM(S)

15.1 Assignment of Antitrust Claim(s)

15.1.1 Contractor recognizes that in actual economic practice, overcharges resulting from antitrust violations are, in fact, usually borne by the ultimate purchaser. Therefore, and as consideration for executing this contract, the Contractor, acting herein by and through its duly authorized agent, hereby conveys, sells, assigns, and transfers to the College, all right, title and interest to all claims and causes of action it may now or hereafter acquire under the antitrust laws of the United States or the State of New Jersey, relating to the particular goods or services purchased or acquired by the College pursuant to this Contract.

In connection with this agreement, the following are the express obligations of the Contractor:

- a. It will take no action which will in any way diminish the value of the rights conveyed or assigned hereunder.
- b. It will advise the Attorney General of New Jersey;
 - (1) In advance of its intention to commence any action on its own behalf regarding such claim or cause(s) of action;
 - (2) Immediately, upon becoming aware of the fact that an action has been commenced on its behalf by some other person(s), of the pendency of such action; and
- c. It will notify the defendants in any antitrust suit of the fact of the within assignment at the earliest practicable opportunity after the contractor has initiated an action on its behalf or becomes aware that such an action has been filed on its behalf by any other person. A copy of such notice will be sent to the Attorney General of New Jersey.

Furthermore, it is understood and agreed that in the event any payment under any such claim or cause of action is made to the Contractor, it shall promptly pay over to the College the aliquot share thereof, if any, assigned to the College hereunder.

ARTICLE 16

AFFIRMATIVE ACTION REQUIREMENTS

16.1 Policy Statement

It has long been the policy of the College to promote equal employment opportunity by prohibiting discrimination in employment and requiring affirmative action in performance of contracts funded by the College. This policy has been reinforced and expended by an act of the Legislature. The new statute, New Jersey Public Law 1975, Chapter 172, provides that no public works contractor can be awarded, nor any monies paid, until the prospective contractor has agreed to contract performance which complies with the approved Affirmative Action Plan. The law applies to each political subdivision and agency of the State and includes procurement and service contracts as well as construction contracts. This section was prepared to explain the affirmative action requirements and procedures for public agencies awarding contracts and for contractors bidding on contracts. To assure effective implementation of the affirmative action law while allowing the business operations of a government to proceed efficiently, these regulations are designed to minimize administrative paperwork, and delays.

16.2 Mandatory Affirmative Action Requirements

16.2.1 N.J.S.A. 10:5-33 and N.J.A.C. 17:27-3.5 require that during the performance of this contract, the contractor must agree as follows:

a) The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will take affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause;

b) The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex;

c) The contractor or subcontractor where applicable, will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

16.2.2 N.J.A.C. 17:27-3.8 requires all contractors and subcontractors, if any, to further agree as follows; .

1) When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. 17:27-7.2; provided, however, that the Division may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by (a)1i and 2 below, as long as the Division is satisfied that the contractor or subcontractor is employing workers provided by a union which

provides evidence, in accordance with standards prescribed by the Division that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with *N.J.A.C. 17:27-7.2*. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

i. If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer, pursuant to *N.J.S.A. 10:5-31* et seq., as supplemented and amended from time to time. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities to minority and women workers directly, consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the procedures prescribed under (a)2 below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

2) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (a)1 above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

i. To notify the public agency compliance officer, the Division, and minority and women referral organizations listed by the Division pursuant to *N.J.A.C. 17:27-5.3*, of its workforce needs, and request referral of minority and women workers;

ii. To notify any minority and women workers who have been listed with it as awaiting available vacancies;

iii. Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

iv. To leave standing requests for additional referral of minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State training and employment service and other approved referral sources in the area;

v. If it is necessary to lay off any of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this chapter, as well as with applicable Federal and State court decisions;

vi. To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(1) The contractor or subcontractor shall interview the referred minority or women worker.

(2) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least

possesses the requisite skills, and experience as recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Division. If necessary, the contractor or subcontractor shall consider the recruitment and hiring or scheduling of minority and women workers who qualify as trainees pursuant to these rules. All of these requirements, however, are limited by the provisions of (a)3 below.

(3) The name of any interested woman or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (a)2vi(2) above, whenever vacancies occur. At the request of the Division, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(4) If, for any reason, a contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Division.

vii. To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Division and submitted promptly to the Division upon request.

3) The contractor or subcontractor agrees that nothing contained in (a)2 above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (a)2 above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey workers ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (a)2 above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

4) After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Division an initial project workforce report (Form AA201) electronically provided to the public agency by the Division, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer. The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on-the-job and/or off-the-job programs for outreach and training of minorities and women.

16.2.3 The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the State Treasurer pursuant to N.J.S.A. 10:5-33, as amended and supplemented from time to time.

AFFIRMATIVE ACTION REQUIREMENT

Notice to Bidders in Event of Award

Construction Contract

"During the performance of this contract, the contractor agrees as follows:

- a. The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation. The contractor will take affirmative action to ensure that such applicants are recruited and employed, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, or sex. Such action shall include but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this non-discrimination clause;
- b. The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation;
- c. The contractor or subcontractor, where applicable, will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d. The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer pursuant to PL 1975, c. 127, as amended and supplemented from time to time."
- e. "When hiring workers in each construction trade, the contractor or subcontractor agrees to attempt in good faith to employ minority and female workers in each construction trade consistent with the applicable employment goal prescribed by N.J.A.C. 17:27 7.3, provided however, that the Affirmative Action Office may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following

provisions A, B, and C as long as the Affirmative Action Office is satisfied that the contractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Affirmative Action Office, that its percentage of active "card carrying" members who are minority and female workers is equal to or greater than the applicable employment goal prescribed by N.J.A.C. 17:27 7.3 promulgated by the Treasurer pursuant to P.L. 1975, c. 127, as amended and supplemented from time to time. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures.

- (A) "If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three (3) days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to P.L. 1975, c. 127, as it is supplemented and amended from time to time. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five (5) days prior to the commencement of construction work, the contractor or subcontractor agrees directly to attempt to hire minority and female workers consistent with the applicable employment goal. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances indicates a significant possibility that the trade union will not refer sufficient minority and female workers consistent with the applicable employment goal, the contractor or subcontractor agrees to be prepared to hire minority and female workers consistent with the applicable employment goal by complying with the following hiring procedures prescribed under (B); and the contractor or subcontractor further agrees immediately to take said action if it determines or is so notified by the Affirmative Action Office that the union is not referring minority and female workers consistent with the applicable employment goal.
- (B) "If the hiring of a workforce consistent with the employment goal has not or cannot be achieved for each construction trade by adhering to the procedures of the preceding provision (A), or if the contractor or subcontractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor agrees to take the following actions consistent with the applicable county employment goal:
 - (1) To notify the Public Agency Compliance Officer, Affirmative Action Office and at least one approved minority referral organization of its manpower needs, and request the referral of minority workers;
 - (2) To notify any minority and female workers who have been listed with it as awaiting available vacancies;
 - (3) Prior to commencement of work, to request the local construction trade union, if the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, to refer minority and female workers to fill job openings;
 - (4) To leave standing requests for additional referral of minority and female

workers with the local construction trade union, if the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State training and employment service and the other approved referral sources in the area until such time as the workforce is consistent with the employment goal;

- (5) If it is necessary to lay off some of the workers in a given trade on the construction site, to assure, consistent with the applicable State and federal statutes and court decisions, that sufficient minority and female employees remain on the site consistent with the employment goal; and to employ any minority and female workers laid off by the contractor or any other construction site in the area on which its workforce composition is not consistent with an employment goal established pursuant to Regulations implementing P.L. 1975, c. 127;
- (6) To adhere to the following procedure when minority and female workers apply or are referred to the contractor or subcontractor:
 - (i) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required, the contractor or subcontractor shall determine the qualifications of such individuals and if the contractor's or subcontractor's workforce in each construction trade is not consistent with the applicable employment goal, it shall employ such persons which satisfy appropriate qualification standards; provided however, that a contractor or subcontractor shall determine that the individual at least possesses the skills and experience recognized by any workers skills and experience classification determination which may have been made by a Public Agency Compliance Officer, union, apprentice program or a referral agency, provided the referral agency is acceptable to the Affirmative Action Office and provided further, that if necessary, the contractor or subcontractor shall hire minority and female workers who qualify as trainees pursuant to subsection 2 (k) of these Regulations. All of the requirements of this paragraph, however, are limited by the provisions of paragraph (C) below.
 - (ii) If the contractor's or subcontractor's workforce is consistent with the applicable employment goal, the name of said female or minority group individual shall be maintained on a waiting list for the first consideration in the event the contractor's or subcontractor's workforce is no longer consistent with the applicable employment goal.
 - (iii) If for any reason said contractor or subcontractor determines said minority individual or a female is not qualified or if said individual qualifies as an advance trainee or apprentice, said contractor or subcontractor shall inform said individual in writing with the reasons for the determination and maintain a copy in its files, and send a copy to the Public Agency Compliance Officer

and to the Affirmative Action Office.

- (7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, and on forms made available by the Affirmative Action Office and shall be submitted promptly to that Office upon request.
- (C) "The contractor or subcontractor agrees that nothing contained in the preceding provision (B) shall preclude the contractor or subcontractor from complying with the hiring hall or apprenticeship provisions in any applicable collective bargaining agreement or hiring hall agreement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement; provided, however, that where the practices of a union or apprenticeship program will result in the exclusion of minorities and females or the failure to refer minorities and females consistent with the county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to said provisions (B) without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ female minority advanced trainees and trainees in numbers which result in the employment of advanced trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also the contractor or subcontractor agrees that, in implementing the procedures of the preceding provision (B), it shall, where practicable, employ minority workers residing within the geographical jurisdiction of the union.

"The contractor agrees to complete an Initial Project Manning Report on forms provided by the Affirmative Action Office or in the form prescribed by the Affirmative Action Office and submit a copy of said form no later than three (3) days after signing a construction contract provided, however, that the public agency may extend in a particular case the allowable time for submitting the form to no more than 14 days; and to submit a copy of the Monthly Project Manning Report once a month (by the 7th work day of each month) thereafter for the duration of this contract to the Affirmative Action Office and to the Public Agency Compliance Office. The contractor agrees to cooperate with the Public Agency in the payment of budgeted funds, as is necessary, for on-the-job and off-the-job programs for outreach and training of minority and female trainees employed on the construction projects."

The contractor and its subcontractors shall furnish such reports or other documents to the Affirmative Action Office as may be requested by the office from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the affirmative action office for conduction a compliance investigation pursuant to Subchapter 10 of the Administrative Code (N.J.A.C 17:27)

Revised 9/98

**State of New Jersey
Executive Department**

EXECUTIVE ORDER NO. 34

Whereas, It is essential that all persons supplying goods or services to the State of New Jersey, or performing contracts or otherwise executing public works with the assistance of and subject to the approval of the State, must meet a standard of responsibility which assures the State and its citizens that such persons will both compete and perform honestly in their dealings with the State and avoid secret or illicit dealing; and

Whereas, It is essential that such persons be fully informed of policies of the State in this regard, and be afforded procedural safeguards appropriate to circumstances which such policies may occasion; and

Whereas, The courts have affirmed the duty and obligation of State officials to develop and effectuate such policies; and

Whereas, It is essential that such policies be uniformly applied by the various agencies of the Executive Branch, and that uniform procedures be adopted to implement them;

Now, Therefore, I, Brendan T. Byrne, Governor of the State of New Jersey, do hereby ORDER and DIRECT that:

1. Debarment, suspension and disqualification are measures which shall be invoked by the State to exclude or render ineligible certain persons from participation in contracts and subcontracts with the State, or in projects or contracts performed with the assistance of and subject to the approval of the State, on the basis of a lack of responsibility. These measures shall be used for the purpose of protecting the interests of the State and not for punishment. To assure the State the benefits to be derived from the full and free competition between and among such persons and to maximize the opportunity for honest competition and performance these measures shall not be invoked for any time longer than deemed necessary to protect the interests of the State.

2. As used in the Order:

(a) "Debarment" means an exclusion from State contracting, on the basis of a lack of responsibility evidenced by an offense, failure, or inadequacy (sic) of performance, for a reasonable period of time commensurate with the seriousness of the offense, failure, or inadequacy of performance.

(b) "Suspension" means an exclusion from State contracting for a temporary period of time, pending the completion of an investigation or legal proceedings.

(c) "Disqualification" means a debarment or a suspension which denies or revokes a qualification to bid or otherwise engage in State contracting which has been granted or applied for pursuant to statute, or rules and regulations.

(d) "State" means the State of New Jersey, or any of the departments or agencies in the Executive Branch of government with the lawful authority to engage in contracting.

(e) "Person" means any natural person, company, firm, association, corporation, or other entity.

(f) "State contracting" means any arrangement giving rise to an obligation to supply any thing to or perform any service for the State, other than by virtue of State employment, or to supply any thing to or perform any service for a private person where the State provides substantial financial assistance and retains the right to approve or disapprove the nature or quality of the goods or service or the persons who may supply or perform the same.

(g) "Affiliates" means persons having an overt or covert relationship such that any one of them directly or indirectly controls or has the power to control another.

3. The executive head of each department or agency in the Executive Branch, with the lawful authority to engage in State contracting, shall, within 90 days of the date of this Order and in accordance with the provisions of the Administrative

Procedures Act (P.L. 1968, c. 410, C. 52:14B-1 et seq.), promulgate rules and regulations governing the causes, conditions and procedures applicable to determinations of debarment, suspension and disqualification by that department or agency. Such rules and regulations shall to the extent consistent with existing law conform to the minimum standards hereinafter set forth, but need not be limited to such standards. In addition to any other filing required by law to be made, each executive head shall file with the Attorney General and the Treasurer a copy of such rules and regulations as may be promulgated.

4. Subject to the conditions hereinafter described, the rules and regulations referred to in Section 3 supra, shall authorize the department or agency to debar a person in the public interest for any of the following causes:

- (a) Commission of a criminal offense as an incident to obtaining or attempting to obtain a public or private contract, or subcontract thereunder, or in the performance of such contract or subcontract.
- (b) Violation of the Federal Organized Crime Control Act of 1970, or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, perjury, false swearing, receiving stolen property, obstruction of justice, or any other offense indicating a lack of business integrity or honesty.
- (c) Violation of the Federal or State Antitrust Statutes, or of the Federal Anti-Kickback Act (18 U.S.C. 874, 40 U.S.C. 276 b, c).
- (d) Violations of any of the laws governing the conduct of elections of the State of New Jersey or of its political subdivisions.
- (e) Violation of the "Law Against Discrimination" (P.L. 1945, c. 169, C. 10:5-1 et seq., as supplemented by P.L. 1975, c. 172), or of the act banning discrimination in public works employment (C. 10:2-1 et seq.) or of the Act prohibiting discrimination by industries engaged in defense work in the employment of persons therein (C. 114, L. 1942, C. 10:1-10 et seq.).
- (f) Violations of any laws governing hours of labor, minimum wage standards, prevailing wage standards, discrimination in wages, or child labor.
- (g) Violations of any laws governing the conduct of occupations or professions or regulated industries.
- (h) Willful failure to perform in accordance with contract specifications or within contractual time limits.
- (i) A record of failure to perform or of unsatisfactory performance in accordance with the terms of one or more contracts, provided that such failure or unsatisfactory performance has occurred within a reasonable time preceding the determination to debar and was caused by acts within the control of the person debarred.
- (j) Violation of contractual or statutory provisions regulating contingent fees.
- (k) Any other cause affecting responsibility as a State contractor of such serious and compelling nature as may be determined by the department or agency to warrant debarment, including such conduct as may be prescribed by the laws or contracts enumerated in this paragraph even if such conduct has not been or may not be prosecuted as violations of such laws or contracts.
- (l) Debarment by some other department or agency in the Executive Branch.

5. The rules and regulations concerning debarment required herein shall include in substance the following conditions:

- (a) Debarment shall be made only upon approval of the executive head of the department or agency, except as otherwise provided by law.
- (b) The existence of any of the causes set forth in paragraph 4 of the Order shall not necessarily require that a person be debarred. In each instance, the decision to debar shall be made within the discretion of the head of the department or agency unless otherwise required by law, and shall be rendered in the best interests of the State.

(c) All mitigating factors shall be considered in determining the seriousness of the offense, failure or inadequacy of performance and in deciding whether debarment is warranted.

(d) The existence of a cause set forth in subparagraphs (a), (b), (c), (d), (e), (f), and (g) of paragraph 4 of this Order shall be established upon the rendering of a final judgement or conviction by a court of competent jurisdiction or by an administrative agency empowered to render such judgement. In the event an appeal taken from such judgement or conviction results in reversal thereof, the debarment shall be removed upon the request of the debarred person unless other cause for debarment exists.

(e) The existence of a cause set forth in subparagraphs (h), (i), (j), and (k) of paragraph 4 of this Order shall be established by evidence which the department or agency determines to be clear and convincing in nature.

(f) Debarment for the cause set forth in subparagraph (l) of paragraph 4 of the Order shall be proper provided that one of the causes set forth in subparagraph 4(a) through 4(k) was the basis for debarment by the original debarring agency. Such debarment may be based entirely on the record of facts obtained by the original debarring agency, or upon a combination of such facts and additional facts.

6. The rules and regulations concerning debarment required by this Order shall include in substance the following provisions regarding procedures, period of debarment and scope of debarment:

(a) A department or agency seeking to debar a person or his affiliates shall furnish such party with a written notice: (i) stating that debarment is being considered, (ii) setting forth the reasons for the proposed debarment, and (iii) indicating that such party will be accorded an opportunity for a hearing if he so requests within a stated period of time. All such hearings shall be conducted in accordance with the provisions of the Administrative Procedures Act. However, where one department or agency has imposed debarment upon a party, a second department or agency may also impose a similar debarment without according an opportunity for a hearing, provided that the second agency furnishes notice of the proposed similar debarment to that party, and accords that party an opportunity to present information in his behalf to explain why the proposed similar debarment should not be imposed in whole or in part.

(b) Debarment shall be for a reasonable, definitely stated period of time which as a general rule shall not exceed 5 years. Debarment for an additional period shall be permitted provided that notice thereof is furnished and the party is accorded an opportunity to present information in his behalf to explain why the additional period of debarment should not be imposed.

(c) Except as otherwise provided by law, a debarment may be removed or the period thereof may be reduced in the discretion of the debarring agency upon oath, supported by documentary evidence, setting forth substantial and appropriate grounds for the granting of relief, such as newly discovered material evidence, reversal of a conviction or judgement, actual change of ownership, management or control, or the elimination of the causes for which the debarment was imposed.

(d) A debarment may include all known affiliates of a person, provided that each decision to include an affiliate is made on a case by case basis after giving due regard to all relevant facts and circumstances. The offense, failure or inadequacy of performance of an individual may be imputed to a person with whom he is affiliated, where such conduct was accomplished within the course of his official duty or was effected by him with the knowledge or approval of such person.

7. Subject to the conditions hereinafter described, the rules and regulations required by this Order shall authorize the department or agency to suspect a person in the public interest for any cause specified in paragraph 4 of this Order, or upon a reasonable suspicion that such cause exists.

8. The rules and regulations concerning suspension required by this Order shall include in substance the following conditions:

(a) Suspension shall be imposed only upon approval of the executive head of the department or agency and upon approval of the Attorney General, except as otherwise provided by law.

(b) The existence of any cause for suspension shall not require that a suspension be imposed, and a decision to suspend shall be made at the discretion of the executive head of the department and of the Attorney General, and shall be rendered in the best interests of the State.

(c) Suspension shall not be based upon unsupported accusation, but upon adequate evidence that cause exists or upon evidence adequate to create a reasonable suspicion that cause exists.

(d) In assessing whether adequate evidence exists, consideration shall be given to the amount of credible evidence which is available, to the existence or absence of corroboration as to important allegations, and to inferences which may properly be drawn from the existence or absence of affirmative facts.

(e) Reasonable suspicion of the existence of a cause described in subparagraphs (a), (b), (c), (d), (e), (f), and (g) of paragraph 4 of this Order may be established by the rendering of a final judgement or conviction by a court or administrative agency of competent jurisdiction, by grand jury indictment, or by evidence that such violations of civil or criminal law did in fact occur.

(f) A suspension invoked by an agency for any of the causes described in subparagraphs (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k), and (l) of paragraph 4 of this Order may be the basis for the imposition of a concurrent suspension by another agency, which may impose such suspension without the approval of the Attorney General.

9. The rules and regulations concerning suspension required by the Order shall include in substance the following provisions regarding procedures, period of suspension and scope of suspension:

(a) A department or agency may suspend a person or his affiliates, provided that within 10 days after the effective date of the suspension, the agency provides such party with a written notice: (i) stating that a suspension has been imposed and its effective date, (ii) setting forth the reasons for the suspension to the extent that the Attorney General determines that such reasons may be properly disclosed, (iii) stating that the suspension is for a temporary period pending the completion of an investigation and such legal proceedings as may ensue, and (iv) indicating that, if such legal proceedings are not commenced or the suspension removed within 60 days of the date of such notice, the party will be given either a statement of the reasons for the suspension and an opportunity for a hearing if he so requests, or a statement declining to give such reasons and setting forth the agency's position regarding the continuation of the suspension. Where a suspension by one agency has been the basis for suspension by another agency, the latter shall note that fact as a reason for its suspension.

(b) A suspension shall not continue beyond 18 months from its effective date unless civil or criminal action regarding the alleged violation shall have been initiated within that period, or unless debarment action has been commenced. Whenever prosecution or debarment action has been initiated, the suspension may continue until the legal proceedings are completed.

(c) A suspension may include all known affiliates of a person, provided that each decision to include an affiliate is made on a case by case basis after giving due regard to all relevant facts and circumstances. The offense, failure or inadequacy of performance of an individual may be imputed to a person with whom he is affiliated, where such conduct was accomplished within the course of his official duty or was effectuated by him with the knowledge or approval of such person.

10. The rules and regulations required by this Order shall contain such provisions as may be necessary to conform existing practices and procedures under any relevant prequalification statutes to the procedures governing debarment and suspension required herein, to the extent that such existing practices and procedures may concern the disqualification of any person from State contracting.

11. The rules and regulations required by this Order shall provide that the exclusion from State contracting by virtue of debarment, suspension or disqualification shall extend to all State contracting and subcontracting within the control or jurisdiction of the department or agency which imposes the exclusion. However, when it is determined essential to the public interest by the head of the department or agency, and upon filing of a finding thereof with the Attorney General, an exception from total exclusion may be made with respect to a particular State contract.

12. Insofar as practicable, prior notice shall be given to the Attorney General and the Treasurer of any proposed debarment or suspension.

13. The Treasurer shall maintain a current list of the names of all persons suspended or debarred, the effective date and term if any thereof, and the agency of agencies which imposed same. Such list shall be available for public inspection.

14. Departments and agencies required by this Order to promulgate rules and regulations governing debarment and suspension are hereby authorized in connection with any proceedings thereunder to receive such information regarding the criminal conduct or criminal record of any person to the extent that such disclosure is deemed appropriate by the Attorney General, consistent with existing Federal and State law.

15. Nothing required by this Order shall be construed to limit the authority of any department or agency to refrain from contracting within the discretion allowed by law.

[seal] Given, under my hand and seal this 29th day of March, in the year of Our Lord, one thousand nine hundred and seventy-six, of the Independence of the United States, the two hundredth.

/s/ BRENDAN BYRNE,
Governor

Attest:

John J. Degnan,
Executive Secretary to the Governor

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**STATE OF NEW JERSEY
Executive Department**

EXECUTIVE ORDER NO. 189

WHEREAS, it is essential that all persons supplying goods or services to the State of New Jersey, or performing contracts or otherwise executing public works with the assistance of and subject to the approval of the State, must meet a standard of responsibility which assures the State and its citizens that such persons will both compete and perform honestly in their dealings with the State and avoid conflicts of interest; and

WHEREAS, the New Jersey Conflicts of Interest Law prohibits State officers or employees and special State officers or employees from having any interest or engaging in any activity that is in substantial conflict with the proper discharge of their duties in the public interest or from undertaking any employment or service which might reasonably be expected to impair their objectivity or independence of judgement; and

WHEREAS, the New Jersey Conflicts of Interest Law prohibits State officers or employees and special State officers or employees from acting in their official capacity in any matter wherein they have a direct or indirect personal financial interest which might reasonably be expected to impair their objectivity or independence of judgement; and

WHEREAS, N.J.S.A. 52:34-19 provides that it shall be a misdemeanor to pay any fee, commission, compensation, gift or gratuity of any kind, directly or indirectly, to any person employed by the Department of the Treasury or to any other person in the employ of the State having any duties or responsibilities in connection with the purchase or acquisition of any property or services by the State or any agency or instrumentality thereof by or on behalf of any seller or supplier of such goods or services or other party to contract with the State; and

WHEREAS, it is essential that persons providing goods or services to, or performing contracts for, the State be fully informed of the policies of the State concerning their relationships with State officers or employees and special State officers or employees and that these policies be uniformly applied by the various agencies of the Executive Branch; and

WHEREAS, it is therefore necessary to supplement Executive Order No. 34 (1976), which provides the grounds and procedures applicable to the debarment, suspension and disqualification of State vendors, to encompass appropriate standards prohibiting conflicts of interest on the part of present and prospective State vendors;

NOW, THEREFORE, I, THOMAS H. KEAN, Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of the State, do hereby ORDER and DIRECT:

1. As used in this Order, "vendor" means any person, firm, corporation, or other entity which provides or offers or proposes to provide goods or services to or perform any contract for any State agency.
2. The executive head of each department or agency in the Executive Branch with the lawful authority to engage in State contracting shall, in accordance with the provisions of the Administrative Procedures Act, N.J.S.A. 52:14B-1 et seq., promulgate regulations supplementing those heretofore established pursuant to Executive Order No. 34 (1976) governing the causes, conditions and procedures applicable to determinations of debarment, suspension and disqualification by the department or agency to include the minimum standards hereinafter set forth. In addition to any other filing required by law to be made, each executive head shall file with the Attorney General and Treasurer a copy of such rules and regulations as may be promulgated.
3. The rules and regulations referred to in Paragraph 2 shall include the following prohibitions on vendor activities, the violation of which shall render said vendor liable to debarment in the public interest, pursuant to the procedures established by Executive Order No. 34 (1976), by any Executive department or agency:
 - a. No vendor shall pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any State officer or employee or special State officer

or employee, as defined by N.J.S.A. 52:13D-13b. and e., in the Department of the Treasury or any other agency with which such vendor transacts or offers or proposes to transact business, or to any member of the immediate family, as defined by N.J.S.A. 52:13D-13i., of any such officer or employee, or any partnership, firm, or corporation with which they are employed or associated, or in which such officer or employee has an interest within the meaning of N.J.S.A. 52:13D-13g.

b. The solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any State vendor shall be reported in writing forthwith by the vendor to the Attorney General and the Executive Commission on Ethical Standards.

c. No vendor may, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such vendor to, any State officer or employee or special State officer or employee having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person, firm or entity with which he is employed or associated or in which he has an interest within the meaning of N.J.S.A. 52:13D-13g. Any relationships subject to this provision shall be reported in writing forthwith to the Executive Commission on Ethical Standards, which may grant a waiver of this restriction upon application of the State officer or employee or special State officer or employee upon a finding that the present or proposed relationship does not present the potential, actuality of appearance of a conflict of interest.

d. No vendor shall influence, or attempt to influence or cause to be influenced, any State officer or employee or special State officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgement of said officer or employee.

e. No vendor shall cause or influence, or attempt to cause or influence, any State officer or employee or special State officer or employee to use, or attempt to use, his official position to secure unwarranted privileges or advantages for the vendor or any other person.

f. The provisions cited above in paragraph 3a through 3e shall not be construed to prohibit a State officer or employee or special State officer or employee from receiving gifts from or contracting with vendors under the same terms and conditions as are offered or made available to members of the general public subject to any guidelines the Executive Commission on Ethical Standards may promulgate under paragraph 3c.

4. The rules and regulations referred to in Paragraph 2, supra, shall require that the prohibitions set forth Paragraph 3, supra, shall be included in all requests for proposals issued by any State department or agency and in all contracts executed on behalf of a State department or agency, other than those of an interstate agency to which New Jersey is a party and contracts entered into on behalf of the interstate agency.

5. Nothing required by this Order shall be construed to limit the authority of any State department or agency to refrain from contracting within the discretion allowed by law, or to limit N.J.S.A. 52:34-19 or any other applicable statute or regulation.

6. This Order shall take effect on the ninetieth day following its execution.

GIVEN, under my hand and seal, this 20th day of July
in the Year of Our Lord, one thousand nine hundred
and eighty-eight, and of the Independence of the
United States, the two hundred and thirteenth.
/s/ Thomas H. Kean
Governor
(seal)
Attest:
/s/ Michael R. Cole, Chief Counsel

**State of New Jersey
Executive Department**

Executive Order #151

WHEREAS, New Jersey is one of the most racially, culturally, and ethnically diverse states in the United States, and this diversity is reflected in the leaders and owners of its businesses, in the leaders and members of the labor movement, and in the employees in every segment of the workforce; and

WHEREAS, the State's business community includes multi-national enterprises, industrial, commercial, and small business sectors; and

WHEREAS, the State's thousands of small businesses, each with fewer than 100 employees, together generate almost 40% of the jobs in the State; and

WHEREAS, small, minority, and women-owned business enterprises have historically been underrepresented in the receipt of State contract awards; and

WHEREAS, the State's workforce provides New Jersey's multinational enterprises, its industrial, commercial, and small business sectors, and its public and not-for-profit sectors with highly educated, highly skilled, and highly motivated employees, who contribute to the prosperity of the State while supporting their families; and

WHEREAS, in response to the current national recession, the United States Congress enacted the American Recovery and Reinvestment Act of 2009 (ARRA), which will increase federal spending at the State and local levels by approximately \$10 billion, and will fully fund certain work in the State, and partially fund other State projects; and

WHEREAS, given the recession and unemployment levels in New Jersey, it is imperative that every sector of the economy be offered the opportunity to benefit from the federal economic recovery funds and the State's own spending; and

WHEREAS, many of the State's businesses have significant public construction contracts and other contracts to provide goods or services to government and many others would like the opportunity to compete for these contracts to expand their businesses while serving the public; and

WHEREAS, residents of the State of New Jersey deserve a government that provides equal opportunity for all contractors to compete to submit winning bids on public contracts; and

WHEREAS, residents of the State of New Jersey, especially during these difficult economic times, deserve a government that does everything it can to expand job opportunities, particularly for men and women who are entering the workforce, who have experienced difficulties entering the workforce, or who have recently become unemployed or underemployed; and

WHEREAS, the State created an internet site, <http://www.recovery.nj.gov>, which outlines the allocation of New Jersey's share of economic recovery funds under the ARRA; and

WHEREAS, to spend ARRA funds transparently and ensure that those seeking work have a fair chance to obtain ARRA-funded employment, State agencies and entities should be required to post all State and ARRA-funded jobs on the State Job Bank internet site, <http://NJ.gov/JobCentralNJ>, to allow New Jersey residents to identify these employment opportunities; and

WHEREAS, the State must procure its construction services, goods, and other services as efficiently as possible, with transparency in the processing, selection, and awarding of public contracts; and

WHEREAS, robust competition for public contracts ensures that the government of the State of New Jersey obtains the construction services, goods, and other services it needs to perform its vital functions with maximum cost effectiveness; and

WHEREAS, broad and sustained efforts to notify all potential bidders of opportunities to contract with government should be encouraged to promote competition for public contracts, thus benefiting the public fisc; and

WHEREAS, the State of New Jersey commissioned the State of New Jersey Construction Services Disparity Study 2000 – 2002 (October 2005) and the State of New Jersey Disparity Study of Procurement in Professional Services, Other Services, and Goods and Commodities (June 2005), and both studies documented significant disparities between the firms ready, willing, and able to do business with the State, and those firms actually awarded contracts by State departments, agencies, authorities, colleges, and universities, as a result of which this Administration created through Executive Order No. 34 (2006) the Division of Minority and Women Business Development (“Division of M/W Business Development”); and

WHEREAS, Executive Order No. 34 charged the Director of the Division of M/W Business Development with monitoring programs to increase the participation of minority and women-owned businesses in the State’s purchasing and procurement processes; and

WHEREAS, since its inception, the Division of M/W Business Development, working with the Department of the Treasury’s Office of Supplier Diversity (“OSD”), has identified strategies to increase the number of small and minority and women-owned businesses interested in and eligible to benefit from state procurement activity; and

WHEREAS, the Division of M/W Business Development and OSD have increased outreach to and expanded the ability of these businesses to fulfill bid requirements for state contracts; and

WHEREAS, the Division of Public Contracts Equal Employment Opportunity Compliance in the Department of the Treasury (Division of Contract Compliance) monitors the employment of women and minorities with businesses that contract with government in an effort to ensure that contractors and vendors make good faith efforts to hire minorities and women in accordance with targeted goals based on the United States Census’ workforce availability statistics;

NOW, THEREFORE, I, JON S. CORZINE, Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER and DIRECT:

1. All members of the public should be afforded the opportunity to benefit from the federal economic recovery funds and associated state spending, and in particular, this Administration re-affirms the State’s commitment, expressed in statute and regulation, that every public contract, whether for construction services, goods, or other services, shall provide equal employment opportunity for women and minorities.
2. The Commissioners of the Departments of Community Affairs, Education, Environmental Protection, and Transportation; the President of the Board of Public Utilities; and the executive directors of the Schools Development Authority and the Economic Development Authority are directed to meet with members of the Governor’s office, the Department of the Treasury, and representatives of the United States Department of Labor’s Office of Federal Contract Compliance Programs (OFCCP) to ensure that those departments receiving the bulk of federal economic recovery funds will provide the OFCCP their complete cooperation in complying with its mandates.
3. The Division of Contract Compliance shall be the entity within the Executive Branch responsible for determining whether minorities and women have been offered a fair opportunity for employment on State contracts. Executive branch departments and agencies, independent authorities, and State colleges and universities are directed to cooperate fully with the Division of Contract Compliance’s enforcement efforts, consistent with law, and to award public contracts only to those businesses that agree to comply with equal employment opportunity and affirmative action requirements.

4. The Division of Contract Compliance shall work cooperatively with the OFCCP, including sharing its workforce data to the maximum extent permitted by law, to assist the OFCCP in its enforcement efforts.

5. When not restricted by any other State or federal law, the Division of Contract Compliance shall determine whether each of the State entities whose performance it monitors (the "Reporting Agencies" listed in Appendix A to this Order) properly allocated and released to the Department of Labor and Workforce Development, as authorized by law, one-half of one percent of the total cost of a construction contract of \$1,000,000 or more, to be used by the department for the New Jersey Builders Utilization Initiative for Labor Diversity program to train minorities and women for employment in construction trades. This provision shall apply to those construction contracts where the funding for the contract consists entirely of appropriated funds or a combination of funds from appropriated funds and other sources.

6. As a result of the aforementioned significant disparities in employment of minorities and women on construction sites and within the construction trades, all construction contracts entered into and funded, in whole or in part, by the State shall include mandatory EEO/AA contract language (in the form of Appendix B to this Order) that requires contractors to make a good faith effort to recruit and employ minorities and women as required by provisions of the Administrative Code, including but not limited to N.J.A.C. 17:27-3.6 to 3.8, and 17:27-7.3 and 7.4. In addition to the language set forth in Appendix B, such construction contracts shall contain the contractual language as required by N.J.A.C. 17-27-3.6, 3.7, and 3.8. As to the portion of each contract that is State funded, the language of the contract shall provide, consistent with Appendix B, that payment may be withheld for failure of the contractor to demonstrate to the satisfaction of the Reporting Agency that the required good faith effort was made. Failure of a contractor to satisfy the good faith effort requirement of its contract may also subject it to assessments imposed pursuant to findings of the Division of Contract Compliance in the Department of the Treasury, in accordance with N.J.A.C. 17:27-10.

7. Except as described in subparagraphs (a) and (b) of this paragraph, each Executive Branch agency that is a recipient of federal economic recovery funds pursuant to ARRA shall include in any contract, grant, or agreement funded in whole or in part with ARRA funds a clause requiring subrecipients, contractors, subcontractors, local education agencies, and vendors to post all job openings created pursuant to the contract, grant, or agreement on the State's Job Bank at least 14 days before hiring is to commence. The clause shall state: "Since the funds supporting this contract, grant, or agreement are provided through the American Recovery and Reinvestment Act of 2009 (ARRA), the subrecipient, contractor, subcontractor, local education agency, or vendor will post any jobs that it creates or seeks to fill as a result of this contract, grant, or agreement. The subrecipient, contractor, subcontractor, local education agency, or vendor will post jobs to the New Jersey State Job Bank by submitting a job order using the form available at <http://NJ.gov/JobCentralNJ>, notwithstanding any other posting the subrecipient, contractor, subcontractor, local education agency, or vendor might make. Any advertisements posted by the subrecipient, contractor, subcontractor, local education agency, or vendor for positions pursuant to this contract, grant, or agreement must indicate that the position is funded with ARRA funds."

a. Posting shall not be required where the employer intends to fill the job opening with a present employee, a laid-off former employee, or a job candidate from a previous recruitment, where pre-existing, legally binding collective bargaining agreements provide otherwise, or where an exception has been granted to the Reporting Agency by the Department of Labor and Workforce Development.

b. Nothing in this Order shall be interpreted to require the employment of apprentices if such employment may result in the displacement of journey workers employed by any employer, contractor or subcontractor.

8. All local government entities and local education agencies that have received or will receive directly from a federal agency federal economic recovery funds are strongly encouraged to require their contractors and subcontractors to post job openings on the State's Job Bank at least 14 days before hiring is to commence. Moreover, all New Jersey employers that enter into contracts funded with ARRA funds received by a local government entity or a local education agency directly from a federal agency are likewise strongly encouraged to post job openings created pursuant to the ARRA.

9. The Division of M/W Business Development shall send to the Reporting Agencies the contractual language set forth in Appendix C of this Order. Provisions of this contractual language have been shown to have a significant impact on

(a) increasing the number of small and minority and women-owned businesses aware of contracting opportunities with the State and (b) increasing the number of such businesses competing for contracts with the State or subcontracts with entities contracting with the State. The Division of M/W Business Development shall work with each Reporting Agency to ensure the reporting of and ensure compliance with contract-specific contracting and subcontracting goals for the Reporting Agency that are consistent with the availability percentages set forth in Appendix D. These goals should incorporate good faith effort requirements and should be adjusted annually, consistent with the availability of minority and women-owned businesses for which significant disparities in utilization have been demonstrated in each business category.

10. Each Reporting Agency shall:

a. Inform the Division of M/W Business Development of contracting opportunities at the same time that it advertises or otherwise posts public notices of such opportunities, via consistent and timely upload of all-inclusive information to the bid opportunities database services managed by the Division of M/W Business Development. All pre-bid requirements shall be prominently advertised at the time of uploading to the Division of M/W Business Development databases;

b. Actively and regularly use the databases and other on-line services managed and operated by the Division of M/W Business Development to identify additional potential bidders. Because these databases and on-line services identify minority and women-owned businesses known to and registered or certified with the Division of M/W Business Development, the ongoing use of these resources by buyers, procurement agents, and other purchasing staff shall be closely monitored by the Reporting Agency's senior management;

c. Contact the businesses identified in the Division of M/W Business Development's databases and on-line services to provide them with notice of the contracting opportunities available through the Reporting Agency; and

d. Report to the Division of M/W Business Development all payments and awards prime contractors have issued to subcontractors, identifying payments and awards to minority and women-owned businesses on at least a quarterly basis.

11. To the maximum extent practicable, and when not restricted by any other State or federal law, each Reporting Agency shall incorporate the substance of the contractual language set forth in Appendix C into its contracts, while continuing to follow the particular State and federal laws and regulations governing its contracting and procurement practices.

12. Each Reporting Agency shall, where substitution of subcontractors or sub-consultants is permitted, promulgate policies governing the circumstances under which contractors or consultants may substitute subcontractors or sub-consultants named in bid proposals or otherwise identified as small or women or minority-owned business subcontractors, sub-consultants, or vendors ("Substitution Policies"). The Substitution Policies shall provide that:

a. The contractor or consultant must notify and obtain approval from a small or women or minority-owned business subcontractor, sub-consultant, or vendor ("SMWBE contractor") before including that contractor in a bid proposal or similar contract-related submission;

b. The contractor or consultant must notify and obtain authorization from the Reporting Agency before it substitutes a SMWBE contractor named in a bid proposal or other contract-related submission; and

c. If the substitution is approved, the contractor or consultant shall make a good faith effort to utilize another SMWBE contractor in place of the previous SMWBE contractor.

13. Each Reporting Agency shall report to the Division of M/W Business Development when it has incorporated the language set forth in Appendix C in its contracts. It shall also report to the Division of M/W Business Development when it has adopted its Substitution Policy, where such policy is permitted. The Division of M/W Business Development shall report on the number of Reporting Agencies that have modified their contracts and adopted a

Substitution Policy at three month intervals until all of the Reporting Agencies have completed incorporation of the contractual language set forth in Appendix C and, where legally permitted, adoption of the Substitution Policy.

14. Nothing in this Order shall modify existing law, state or federal, or authorize a Reporting Agency to amend, modify, or otherwise alter pre-existing legal obligations. Further, this Order shall be interpreted consistently with the ARRA, and the federal regulations and guidelines governing its implementation, and in the event of a conflict between this Order and federal law governing ARRA, the Order shall be interpreted to comply with federal law.

15. Within 90 days of the date of this Order, the Division of M/W Business Development shall prepare a Contracting Guide identifying the management practices that have the greatest success in: (a) increasing the number of small and minority and women-owned businesses made aware of contracting opportunities with the State; and (b) increasing the number of such businesses competing for contracts with the state or subcontracts with entities contracting with the state. As soon as practicable thereafter, the Division of M/W Business Development shall distribute the Contracting Guide to the Reporting Agencies.

16. As soon as practicable after its receipt of the Contracting Guide, each Reporting Agency shall implement those provisions that it views as most likely to have the greatest impact in increasing contracting opportunities for small and minority and women-owned businesses.

17. Within one year and ninety days of the effective date of this Order, the Division of M/W Business Development and the Division of Contract Compliance shall each prepare a report describing the Reporting Agencies' implementation of this Order. The Division of M/W Business Development and the Division of Contract Compliance each shall prepare a second report within one year of issuing its first report.

18. The Department of Labor and Workforce Development shall work together with all other Reporting Agencies that will receive ARRA funding and with the representatives of the United States Environmental Protection Agency, the Federal Departments of Labor, Energy, Transportation, and Housing and Urban Development, and any other federal agencies distributing ARRA funds to:

- a. Coordinate with labor unions that will aggressively recruit minorities and women for apprenticeships and training opportunities;
- b. Increase outreach to and enrollment of minorities and women in apprenticeship, training, and related programs; and
- c. Ensure that, to the greatest extent possible under the law, minorities and women apprentices and trainees are working on State and ARRA-funded work sites.

19. The Department of the Treasury and other departments, agencies, and independent authorities shall, consistent with law, take steps to increase their engagement of small, minority, or women-owned or controlled banks and credit unions to meet their financial services needs.

20. This Order shall take effect immediately.

GIVEN, under my hand and seal this 28th day of August
Two Thousand and Nine, and of the Independence of
the United States, the Two Hundred and Thirty-Fourth.

/s/ Jon S. Corzine

Governor

[seal]

Attest:

/s/ Kay Walcott-Henderson

First Assistant Chief Counsel

APPENDIX A

LIST OF REPORTING AGENCIES

Board of Public Utility Commissioners
Casino Control Commission
Casino Reinvestment Development Authority
Commission on Higher Education
Commission on Science & Technology
Council on Affordable Housing
Department of Agriculture
Department of Military & Veterans' Affairs
Department of Banking & Insurance
Department of Children & Families
Department of Community Affairs
Department of Corrections
Department of Education
Department of Environmental Protection
Department of Health and Senior Services
Department of Human Services
Department of Labor and Workforce Development
Department of Law & Public Safety
Department of Public Advocate
Department of State
Department of Transportation
Department of the Treasury
Division of Property Management and Construction
Election Law Enforcement Commission
Fort Monmouth Economic Revitalization Planning Authority
Garden State Preservation Trust
Higher Education Student Assistance Authority
Kean University
Legalized Games of Chance Control Commission
Montclair State University
Motion Picture Commission
Motor Vehicle Commission
New Jersey City University
New Jersey Cultural Trust
New Jersey Institute of Technology
New Jersey Transit
NJ Building Authority
NJ Economic Development Authority
NJ Educational Facilities Authority
NJ Environmental Infrastructure Trust
NJ Health Care Facilities Financing Authority
NJ Highlands Council
NJ Housing & Mortgage Finance Agency
NJ Maritime Pilot and Docking Pilot Commission
NJ Meadowlands Commission
NJ Pinelands Commission
NJ Public Television & Radio (NJN) NJ Racing Commission NJ Redevelopment Authority
NJ Schools Development Authority
NJ Sports & Exposition Authority
NJ State Museum
NJ Turnpike Authority

NJ Water Supply Authority
North Jersey Transportation Planning Authority
North Jersey District Water Supply Commission
Office of Homeland Security
Office of Information Technology
Office of the Child Advocate
Office of the Inspector General
Office of the Public Defender
Ramapo College
Rowan University
Rutgers University
South Jersey Port Corporation
South Jersey Transportation Authority
South Jersey Transportation Planning Organization
State Agriculture Development Committee
State Economic Recovery Board For Camden
State Ethics Commission
State Employment & Training Commission
State Lottery Commission
Stockton College
The College of New Jersey
Thomas Edison State College
Transportation Trust Fund Authority
University of Medicine & Dentistry of New Jersey
William Paterson University

APPENDIX B

It is the policy of the [Reporting Agency] that its contracts should create a workforce that reflects the diversity of the State of New Jersey. Therefore, contractors engaged by the [Reporting Agency] to perform under a construction contract shall put forth a good faith effort to engage in recruitment and employment practices that further the goal of fostering equal opportunities to minorities and women.

The contractor must demonstrate to the [Reporting Agency]'s satisfaction that a good faith effort was made to ensure that minorities and women have been afforded equal opportunity to gain employment under the [Reporting Agency]'s contract with the contractor. Payment may be withheld from a contractor's contract for failure to comply with these provisions.

Evidence of a "good faith effort" includes, but is not limited to:

1. The Contractor shall recruit prospective employees through the State Job bank website, managed by the Department of Labor and Workforce Development, available online at <http://NJ.gov/JobCentralNJ>.
2. The Contractor shall keep specific records of its efforts, including records of all individuals interviewed and hired, including the specific numbers of minorities and women.
3. The Contractor shall actively solicit and shall provide the [Reporting Agency] with proof of solicitations for employment, including but not limited to advertisements in general circulation media, professional service publications and electronic media.
4. The Contractor shall provide evidence of efforts described at 2 above to the [Reporting Agency] no less frequently than once every 12 months.

5. The Contractor shall comply with the requirements set forth at N.J.A.C. 17:27.

APPENDIX C

It is the policy of the [Reporting Agency] that small businesses (each a “small business enterprise” or “SBE”), as determined and defined by the State of New Jersey, Division of Minority and Women Business Development (“Division”) and the New Jersey Department of the Treasury (“Treasury”) in N.J.A.C. 17:14 et seq. or other application regulation, should have the opportunity to participate in [Reporting Agency] Contracts.

To the extent the Firm engages subcontractors or sub-consultants to perform Services for the [Reporting Agency] pursuant to this Contract, the Firm must demonstrate to the [Reporting Agency]’s satisfaction that a good faith effort was made to utilize subcontractors and sub-consultants who are registered with the Division as SBEs. Furthermore, the Reporting Agency shall be evaluated quarterly by the Division, based on its attainment of the Participation Goals set forth in the State of New Jersey Construction Services Disparity Study (October 2005) and the State of New Jersey Disparity Study of Procurement in Professional Services, Other Services, and Goods and Commodities (June, 2005). (These participation goals are set forth below.)

Evidence of a “good faith effort” includes, but is not limited to:

1. The Firm shall request listings of SBEs from the Division (609) 292-2146 and/or the [Reporting Agency] and attempt to contact same.
2. The Firm shall keep specific records of its efforts, including records of all requests made to the Division, the names of SBEs contacted, and the means and results of such contacts, including without limitation receipts from certified mail and telephone records. 3. The Firm shall actively solicit and shall provide the [Reporting Agency] with proof of solicitations of SBEs for the provision of Services, including advertisements in general circulation media, professional service publications and small business, minority-owned business or women-owned business focus media.
4. The Firm shall provide evidence of efforts made to identify categories of Services capable of being performed by SBEs.
5. The Firm shall provide all potential subcontractors and sub-consultants that the Firm has contacted pursuant to 2 or 3 above with detailed information regarding the scope of work of the subject contract.
6. The Firm shall provide evidence of efforts made to use the goods and/or services of available community organizations, consultant groups, and local, State, and federal agencies that provide assistance in the recruitment and placement of SBEs.

Furthermore, the Firm shall submit proof of its subcontractors’ and/or sub-consultants’ SBE registrations on the form attached as Exhibit ___, and shall complete such other forms as may be required by the [Reporting Agency] for State reporting as to participation.

Participation Goals

1. Construction Services Contracts/Subcontracts (including new construction and renovations, except routine building maintenance; residential and non-residential building construction; heavy construction, such as streets, roads and bridges; and special trade construction, such as fencing, HVAC, paving and electrical).

(a) State Agencies/Authorities/Commissions

African Americans -- 6.3%
Asian Americans -- 4.34%

(b) State Colleges and Universities

African Americans -- 6.3%
Asian Americans -- 4.34%
Caucasian Females -- 12.67%

2. Construction-Related Services Contracts/Subcontracts (including design services, such as architectural, engineering and construction management services, that are performed as part of a construction project).

State Colleges and Universities

African Americans -- 4.51%
Asian Americans -- 7.11%
Hispanics -- 4.09%

3. Professional Services (with the exception of those professional services deemed to be construction-related, all services that are of a professional nature and requiring special licensing, education degrees and/or very highly specialized expertise, including accounting and financial services, advertising services, laboratory testing services; legal services; management consulting services; technical services and training).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 2.47%
Asian Americans -- 1.47%
Hispanics -- 1.1%
Native Americans -- 0.07%
Caucasian Females -- 3.74%

4. Other Services (any service that is labor-intensive and neither professional nor construction-related, including, but not limited to equipment rental; janitorial and maintenance services; landfill services; laundry and dry cleaning; maintenance and repairs; printing; real property services; security services; special department supplies; subsidy, care and support; telecommunications; and temporary help).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 1.22%
Asian Americans -- 0.85%
Hispanics -- 0.67%
Native Americans -- 0.05%
Caucasian Females -- 1.96%

5. Goods and Commodities (equipment and consumable items purchased in bulk, or a deliverable product including, but not limited to automobiles and equipment; chemicals and laboratory supplies, construction materials and supplies; equipment parts and supplies; fuels and lubricants; janitorial and cleaning supplies; office equipment; office supplies; radio equipment; special department supplies; technical supplies; tires and tubes; traffic signals; and uniforms).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 2.71%
Asian Americans -- 1.74%
Hispanics -- 1.32%
Native Americans -- 0.10%
Caucasian Females -- 4.45%

Appendix D

Consistent with the findings of the State of New Jersey Construction Services Disparity Study (October 2005) and the State of New Jersey Disparity Study of Procurement in Professional Services, Other Services, and Goods and Commodities (June 13, 2005), each Reporting Agency should aspire to allocate a portion of its total contracting dollars in accordance with the following goals.

1. Construction Services Contracts/Subcontracts (including new construction and renovations, except routine building maintenance; residential and non-residential building construction; heavy construction, such as streets, roads and bridges; and special trade construction, such as fencing, HVAC, paving and electrical).

(c) State Agencies/Authorities/Commissions

African Americans -- 6.3%

Asian Americans -- 4.34%

(d) State Colleges and Universities

African Americans -- 6.3%

Asian Americans -- 4.34%

Caucasian Females -- 12.67%

2. Construction-Related Services Contracts/Subcontracts (including design services, such as architectural, engineering and construction management services, that are performed as part of a construction project).

State Colleges and Universities

African Americans -- 4.51%

Asian Americans -- 7.11%

Hispanics -- 4.09%

2. Professional Services (with the exception of those professional services deemed to be construction-related, all services that are of a professional nature and requiring special licensing, education degrees and/or very highly specialized expertise, including accounting and financial services, advertising services, laboratory testing services; legal services; management consulting services; technical services and training).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 2.47%

Asian Americans -- 1.47%

Hispanics -- 1.1%

Native Americans -- 0.07%

Caucasian Females -- 3.74%

3. Other Services (any service that is labor-intensive and neither professional nor construction-related, including, but not limited to equipment rental; janitorial and maintenance services; landfill services; laundry and dry cleaning; maintenance and repairs; printing; real property services; security services; special department supplies; subsidy, care and support; telecommunications; and temporary help).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 1.22%
Asian Americans -- 0.85%
Hispanics -- 0.67%
Native Americans -- 0.05%
Caucasian Females -- 1.96%

4. Goods and Commodities (equipment and consumable items purchased in bulk, or a deliverable product including, but not limited to automobiles and equipment; chemicals and laboratory supplies, construction materials and supplies; equipment parts and supplies; fuels and lubricants; janitorial and cleaning supplies; office equipment; office supplies; radio equipment; special department supplies; technical supplies; tires and tubes; traffic signals; and uniforms).

State Agencies/Authorities/Commissions/Colleges and Universities

African Americans -- 2.71%
Asian Americans -- 1.74%
Hispanics -- 1.32%
Native Americans -- 0.10%
Caucasian Females -- 4.45%

GIVEN, under my hand and seal this 28th day of August
Two Thousand and Nine, and of the Independence of
the United States, the Two Hundred and Thirty-Fourth.

/s/ Jon S. Corzine

Governor

[seal]

Attest:

/s/ Kay Walcott-Henderson

First Assistant Chief Counsel

Public Law 2005, Chapter 51
Effective October 15, 2004

To be eligible for an award, a vendor must comply with the requirements of Public Law 2005, Chapter 51 (N.J.S.A. 19:44A-20.13-20.25, superseding Executive Order 134 (2004)).

CHAPTER 51

AN ACT concerning campaign contributions by certain business entities seeking or holding State contracts, supplementing P.L.1973, c.83 (C.19:44A-1 et seq.), amending P.L.2004, c.19, and repealing section 1 of P.L.2004, c.19 (C.19:44A-20.2).

BE IT ENACTED by the Senate and General Assembly of the State of New Jersey:

C.19:44A-20.13 Findings, declarations relative to certain campaign contributions by business entities.

1. The Legislature finds and declares that:

In our representative form of government, it is essential that individuals who are elected to public office have the trust, respect and confidence of the citizenry; and

All individuals, businesses, associations, and other persons have a right to participate fully in the political process of New Jersey, including making and soliciting contributions to candidates, political parties and holders of public office; and

When a person or business interest makes or solicits major contributions to obtain a contract awarded by a government agency or independent authority, this constitutes a violation of the public's trust in government and raises legitimate public concerns about whether the contract has been awarded on the basis of merit; and
The growing infusion of funds donated by business entities into the political process at all levels of government has generated widespread cynicism among the public that special interest groups are "buying" favors from elected officeholders; and

For the purposes of protecting the integrity of government contractual decisions and of improving the public's confidence in government, it is a compelling interest of this State to prohibit awarding government contracts to business entities which are also contributors to candidates, political parties and the holders of public office; and
There exists the perception that campaign contributions are often made to a State or county political party committee by an individual or business seeking favor with State elected officials, with the understanding that the money given to such a committee will be transmitted to other committees in other parts of the State, or is otherwise intended to circumvent legal restrictions on the making of political contributions or gifts directly to elected State officials, thus again making elected State officials beholden to those contributors; and

County political party committees, through their powers of endorsement, fundraising, ballot slogan or party line designation, and other means, exert significant influence over the gubernatorial primary and general election process; and

Although the right of individuals and businesses to make campaign contributions is unequivocal, that right may be limited, even abrogated, when such contributions promote the actuality or appearance of public corruption; and
It is essential that the public have confidence that the selection of State contractors is based on merit and not on political contributions made by such contractors and it is essential that the public have trust in the processes by which taxpayer dollars are spent; and

It has long been the public policy of this State to secure for the taxpayers the benefits of competition, to promote the public good by promoting the honesty and integrity of bidders for public contracts and the system, and to guard against favoritism, improvidence, extravagance and corruption in order to benefit the taxpayers; and
In the procurement process, our public policy grants to the State broad discretion, taking into consideration all factors, to award a contract to a bidder whose proposal will be most advantageous to the State; and

The operations of the State government must be effectively and fairly managed to ensure public order and prosperity, and malfeasance, in whatever form it may take, must be confronted and uprooted; and The Legislature must safeguard the integrity of State government procurement by imposing restrictions on State agencies and independent authorities to insulate the negotiation and award of State contracts from political contributions that pose the risk of improper influence, purchase of access, or the appearance thereof.

C.19:44A-20.14 Contributors, certain, ineligibility to enter into agreement with the State or its authorities.

2. The State or any of its purchasing agents or agencies or those of its independent authorities, as the case may be, shall not enter into an agreement or otherwise contract to procure from any business entity services or any material, supplies or equipment, or to acquire, sell, or lease any land or building, where the value of the transaction exceeds \$17,500, if that business entity has solicited or made any contribution of money, or pledge of contribution, including in-kind contributions to a candidate committee or election fund of any candidate or holder of the public office of Governor, or to any State or county political party committee: (i) within the eighteen months immediately preceding the commencement of negotiations for the contract or agreement; (ii) during the term of office of a Governor, in the case of contributions to a candidate committee or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of such term; or (iii) within the eighteen months immediately preceding the last day of the term of office of Governor, in which case such prohibition shall continue through the end of the next immediately following term of the office of Governor, in the case of contributions to a candidate committee or election fund of the holder of that office, or to any State or county political party committee of a political party nominating such Governor in the last gubernatorial election preceding the commencement of the latter term.

C.19:44A-20.15 Certain contributions prohibited by certain contractors of the State or its authorities.

3. No business entity which agrees to any contract or agreement with the State or any department or agency thereof or its independent authorities either for the rendition of services or furnishing of any material, supplies or equipment or for the acquisition, sale, or lease of any land or building, if the value of the transaction exceeds \$17,500, shall knowingly solicit or make any contribution of money, or pledge of a contribution, including in-kind contributions, to a candidate committee or election fund of any candidate or holder of the public office of Governor or to any State or county political party committee prior to the completion of the contract or agreement.

C.19:44A-20.16 "Contribution" defined.

4. For the purposes of this act, a "contribution" means a contribution reportable by the recipient under "The New Jersey Campaign Contributions and Expenditures Reporting Act, " P.L.1973, c.83 (C.19:44A-1 et seq.) made on or after the effective date of this act.

C.19:44A-20.17 "Business entity" defined.

5. For the purposes of this act, a "business entity" means any natural or legal person, business corporation, professional services corporation, limited liability company, partnership, limited partnership, business trust, association or any other legal commercial entity organized under the laws of this State or any other state or foreign jurisdiction. The definition of a business entity includes: (i) all principals who own or control more than 10 percent of the profits or assets of a business entity or 10 percent of the stock in the case of a business entity that is a corporation for profit, as appropriate; (ii) any subsidiaries directly or indirectly controlled by the business entity; (iii) any political organization organized under section 527 of the Internal Revenue Code that is directly or indirectly controlled by the business entity, other than a candidate committee, election fund, or political party committee; and (iv) if a business entity is a natural person, that person's spouse or child, residing therewith, are also included within this definition.

C.19:44A-20.18 Report of contributions by business entities as part of State procurement process.

6. Prior to awarding any contract or agreement to procure services or any material, supplies or equipment from, or for the acquisition, sale, or lease of any land or building from or to, any business entity, the State or any of its purchasing agents or agencies, as the case may be, shall require, as part of the procurement process, the business entity to report all contributions the business entity made during the preceding four years to any political organization organized under section 527 of the Internal Revenue Code that also meets the definition of a "continuing political committee" within the meaning of section 3 of P.L.1973, c.83 (C.19:44A-3). Such reporting shall be made in a manner and form to be developed by the State Treasurer with the advice of the New Jersey Election Law Enforcement Commission, which agencies shall promulgate regulations to effect and implement this

disclosure obligation. Such reports shall be subject to review by the State Treasurer. If the State Treasurer determines that any such contribution, or any other act that would constitute a breach of contract pursuant to section 9 of this act, poses a conflict of interest in the awarding of any contract or agreement, the State Treasurer shall disqualify such business entity from bidding on or being awarded such contract or agreement.

C.19:44A-20.19 Written certification by business entities relative to contributions.

7. Prior to awarding any contract or agreement to procure services or any material, supplies or equipment from, or for the acquisition, sale, or lease of any land or building from or to, any business entity, the State or any of its purchasing agents or agencies or independent authorities, as the case may be, shall require the business entity to provide a written certification that it has not made a contribution that would bar the award of the contract pursuant to this act. The business entity shall have a continuing duty to report any contribution it makes during the term of the contract. Such reports shall be subject to review by the State Treasurer. If the State Treasurer determines that any such contribution poses a conflict of interest, such contribution shall be deemed a material breach of such contract or agreement.

C.19:44A-20.20 Request for reimbursement of contribution.

8. If a business entity inadvertently makes a contribution that would otherwise bar it from receiving a contract or makes a contribution during the term of a contract in violation of this act, the entity may request a full reimbursement from the recipient and, if such reimbursement is received within 30 days after the date on which the contribution was made, the business entity would again be eligible to receive a contract or would no longer be in violation, as appropriate. It shall be presumed that contributions made within 60 days of a gubernatorial primary or general election were not made inadvertently.

C.19:44A-20.21 Breach of terms of government contract concerning contributions.

9. It shall be a breach of the terms of the government contract for a business entity to: (i) make or solicit a contribution in violation of this act; (ii) knowingly conceal or misrepresent a contribution given or received; (iii) make or solicit contributions through intermediaries for the purpose of concealing or misrepresenting the source of the contribution; (iv) make or solicit any contribution on the condition or with the agreement that it will be contributed to a campaign committee of any candidate or holder of the public office of Governor, or to any State or county party committee; (v) engage or employ a lobbyist or consultant with the intent or understanding that such lobbyist or consultant would make or solicit any contribution, which if made or solicited by the business entity itself, would subject that entity to the restrictions of this act; (vi) fund contributions made by third parties, including consultants, attorneys, family members, and employees; (vii) engage in any exchange or contributions to circumvent the intent of this act, or (viii) directly or indirectly, through or by any other person or means, do any act which would subject that entity to the restrictions of this act.

C.19:44A-20.22 Exception for public exigency.

10. This act shall not prohibit the awarding of a contract when the public exigency requires the immediate delivery of goods or performance of services as determined by the State Treasurer.

C.19:44A-20.23 Applicability of act to State agencies and authorities.

11. This act shall apply to all State agencies including any of the principal departments in the Executive Branch, and any division, board, bureau, office, commission or other instrumentality within or created by such department and any independent State authority, board, commission, instrumentality or agency.

C.19:44A-20.24 Contract, bid applications and specs to describe requirements of act.

12. Every contract and bid application and specifications promulgated in connection therewith covered by this act shall contain a provision describing the requirements of this act and a statement that compliance with this act shall be a material term and condition of said contract or bid application and binding upon the parties thereto upon the entry of all applicable contracts.

C.19:44A-20.25 Inapplicability of act under federal law or eminent domain.

13. The provisions of sections 1 through 12 of this act, P.L.2005, c.51, shall not: a. apply in circumstances when it is determined by the federal government or a court of competent jurisdiction that its application would violate federal law or regulation; or b. prevent the State, its executive departments, agencies or independent authorities from complying with all of the requirements, conditions and obligations of the "Eminent Domain Act of 1971," P.L.1971,

c.361 (C.20:3-1 et seq.), as amended and supplemented.

14. Section 6 of P.L.2004, c.19 (C.19:44A-20.7) is amended to read as follows:

C.19:44A-20.7 Definitions relative to certain campaign contributions.

6. As used in sections 2 through 12 of this act:

"business entity" means any natural or legal person, business corporation, professional services corporation, limited liability company, partnership, limited partnership, business trust, association or any other legal commercial entity organized under the laws of this State or of any other state or foreign jurisdiction;

"interest" means the ownership or control of more than 10% of the profits or assets of a business entity or 10% of the stock in the case of a business entity that is a corporation for profit, as appropriate;

"fair and open process" means, at a minimum, that the contract shall be: publicly advertised in newspapers or on the Internet website maintained by the public entity in sufficient time to give notice in advance of the contract; awarded under a process that provides for public solicitation of proposals or qualifications and awarded and disclosed under criteria established in writing by the public entity prior to the solicitation of proposals or qualifications; and publicly opened and announced when awarded. The decision of a public entity as to what constitutes a fair and open process shall be final.

"State agency in the Legislative Branch" means the Legislature of the State and any office, board, bureau or commission within or created by the Legislative Branch.

15. Section 7 of P.L.2004, c.19 (C.19:44A-20.8) is amended to read as follows:

C.19:44A-20.8 Business entity to provide written certification, ELEC reports.

7. a. Prior to awarding any contract, except a contract that is awarded pursuant to a fair and open process, a State agency in the Legislative Branch, a county, or a municipality shall require the business entity to which the contract is to be awarded to provide a written certification that it has not made a contribution that would bar the award of a contract pursuant to this act.

b. A business entity shall have a continuing duty to report to the Election Law Enforcement Commission any contributions that constitute a violation of this act that are made during the duration of a contract.

Repealer.

16. Section 1 of P.L.2004, c.19 (C.19:44A-20.2) is repealed.

Superseder.

17. Executive Order No. 134 (2004) is hereby superseded.

18. Sections 14, 15 and 16 shall take effect on the original effective date of P.L.2004, c.19

P.L. 2005, CHAPTER 51

5

(C.19:44A-20.2 et seq.), and the remainder of this act shall take effect immediately and shall be retroactive to October 15, 2004 and shall apply to contributions made and contracts awarded on or after October 15, 2004.

Approved March 22, 2005.

WAGE RATE REQUIREMENT

NOTICE

TO ALL PUBLIC WORKS EMPLOYERS:

Please be advised that effective February 18, 1992 Regulation N.J.A.C. 12:60-2.1 and 6.1 of the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. requires that all public works employers shall submit a certified payroll record to the public body or lessor which contracted for the public work project each payroll period within ten (10) days of the payment of wages. The public body shall receive, file and make available for inspection during normal business hours the certified payroll records.

A copy of the certified payroll form may be obtained by contacting the New Jersey Department of Labor and Workforce Development, Division of Wages and Hour Compliance, Public Contracts Section, 1 John Fitch Plaza, P.O. Box 110, Trenton, NJ 08625-0110, telephone (609) 292-2259.

rev (7-02)



STATE OF NEW JERSEY
Department of Labor and Workforce Development
Division of Wage and Hour Compliance - Public Contracts Section
PO Box 389
Trenton, NJ 08625-0389

PREVAILING WAGE RATE DETERMINATION

The New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25 et seq.) requires that the Department of Labor and Workforce Development establish and enforce a prevailing wage level for workers engaged in public works in order to safeguard their efficiency and general well being and to protect them as well as their employers from the effects of serious and unfair competition.

Prevailing wage rates are wage and fringe benefit rates based on the collective bargaining agreements established for a particular craft or trade in the locality in which the public work is performed. In New Jersey, these rates vary by county and by the type of work performed.

Applicable prevailing wage rates are those wages and fringe benefits in effect on the date the contract is awarded. All pre-determined rate increases listed at the time the contract is awarded must also be paid, beginning on the dates specified. Rates that have expired will remain in effect until new rates are posted.

Prevailing Wage Rate

The prevailing wage rate for each craft will list the effective date of the rate and the following information:

W = Wage Rate per Hour

B = Fringe Benefit Rate per Hour*

T = Total Rate per Hour

- * Fringe benefits are an integral part of the prevailing wage rate. Employers not providing such benefits must pay the fringe benefit amount directly to the employee each payday. Employers providing benefits worth less than the fringe benefit amount must pay the balance directly to the employee each payday.

Unless otherwise stated in the Prevailing Wage Rate Determination, the fringe benefit rate for overtime hours remains at the straight time rate.

When the Overtime Notes in the Prevailing Wage Rate Determination state that the overtime rates are "inclusive of benefits," the benefit rate is increased by the same factor as the wage rate (i.e. multiplied by 1.5 for time and one-half, multiplied by 2 for double time, etc.).

Apprentice Rate Schedule

An "apprentice" is an individual who is registered with the United States Department of Labor - Office of Apprenticeship and enrolled in a certified apprenticeship program during the period in which they are working on the public works project.

The apprentice wage rate is a percentage of the journeyman wage rate, unless otherwise indicated. The apprentice benefit rate is the full journeyman benefit rate, unless otherwise indicated.

If there is no apprentice rate schedule listed, the individual must be paid at least the journeyman rate even if that individual is in a certified apprentice program for that trade.

If there is no ratio of apprentices to journeymen listed for a particular craft, then the ratio shall be one (1) apprentice to every four (4) journeymen.

Comments/Notes

For each craft listed there will be comments/notes that cover the definition of the regular workday, shift differentials, overtime, recognized holidays, and any other relevant information.

Public Works Contractor Registration

The Public Works Contractor Registration Act (N.J.S.A. 34:11-56.48, et seq.) requires that **all** contractors, subcontractors, or lower tier subcontractors who are working on or who bid on public works projects register with the Department of Labor and Workforce Development. Applications are available at www.nj.gov/labor (click on Wage & Hour and then go to Registration & Permits).

Pursuant to N.J.S.A. 34:11-56.51:

No contractor shall bid on any contract for public work as defined in section 2 of P.L.1963, c. 150 (C.34:11-56.26) unless the contractor is registered pursuant to this act. No contractor shall list a subcontractor in a bid proposal for the contract unless the subcontractor is registered pursuant to P.L.1999, c.238 (C.34:11-56.48 et seq.) at the time the bid is made. No contractor or subcontractor, including a subcontractor not listed in the bid proposal, shall engage in the performance of any public work subject to the contract, unless the contractor or subcontractor is registered pursuant to that act.

Snow Plowing

Snow plowing contracts are not subject to the New Jersey Prevailing Wage Act or the Public Works Contractor Registration Act.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Air Conditioning & Refrigeration - Service and Repair

PREVAILING WAGE RATE

	03/01/14
Journeyman (Mechanic)	W34.93 B19.39 T54.32

Expiration Date: 02/28/2015

Craft: Air Conditioning & Refrigeration - Service and Repair

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
As Shown	Mo. 1-3	Mo. 4-12	2nd Year	3rd Year	4th Year	5th Year		Wage = %	of Jnymn	Wage
Wage and Bene	50%	55%	60%	65%	75%	85%		Bene = %	of Jnymn	Bene

Ratio of Apprentices to Journeymen - 1:4

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM AFTER 3-1-13:

INTERVAL	PERIOD AND RATES						
As Shown	1st Year	2nd Year	3rd Year	4th Year	5th Year		Wage =% of Jnymn Wage
Wage and Benefit	40%	50%	60%	70%	80%		Bene. =% of Jnymn Wage

Craft: Air Conditioning & Refrigeration - Service and Repair

COMMENTS/NOTES

THESE RATES MAY BE USED FOR THE FOLLOWING:

- Service/Repair/Maintenance Work to EXISTING facilities.
- Replacement or Installation of air conditioning and refrigeration equipment when the combined tonnage does not exceed 15 tons for refrigeration, or 25 tons for air conditioning.
- Replacement or Installation of "packaged" or "unitary" rooftop-type units when the combined tonnage of the units does not exceed 75 tons.

NOTE: These rates may NOT be used for any work in new construction (including work on new additions).

The regular workday shall consist of 8 hours, starting between 6:00 AM and 10:00 AM, Monday through Friday.

SHIFT DIFFERENTIALS:

- The second and third shifts shall be paid an additional 15% of the hourly rate.
- All shifts must run for a minimum of 5 consecutive days.

OVERTIME:

Hours in excess of 8 per day, hours before or after the regular workday that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Boilermaker

PREVAILING WAGE RATE

	01/09/15
Foreman	W45.00 B40.02 T85.02
General Foreman	W47.00 B41.00 T88.00
Journeyman	W41.00 B38.42 T79.42

Expiration Date: 12/31/2015

Craft: Boilermaker

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
1000 Hours	65%	70%	75%	80%	85%	90%	95%			
Benefit =	32.33	33.20	34.08	34.94	35.82	36.69	37.55			

Ratio of Apprentices to Journeymen - *

* 1 apprentice will be allowed for the first 5 journeyman, 1 apprentice for the next 10 journeymen and 1 apprentice for each succeeding 20 journeymen up to a maximum of 5 apprentices per contractor on any one job.

Craft: Boilermaker

COMMENTS/NOTES

HIGH WORK: All apprentices working on the erection, repair, or dismantling of smoke stacks, standpipes, or water towers shall be paid the Journeyman rate.

The regular workday shall consist of 8 hours, between 8:00 AM and 4:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall work 7½ hours and receive 8 hours pay, at a rate equal to the regular hourly rate plus 10%.
- The third shift shall work 7 hours and receive 8 hours pay, at a rate equal to the regular hourly rate plus 20%.
- For "Municipal Water Works" projects only, the following shall apply: Two, four day, 10 hour shifts may be worked at straight time Monday through Thursday. The day shift shall work four days, at 10 hours, for 10 hours pay. The second shift shall work four days, at nine and a half hours, for 10 hours pay, plus 10% the hourly rate for new work and .25 cents on repair work. Friday may be used as a make-up day at straight time, due to weather conditions, holiday or any other circumstances beyond the employer's control.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays (except Labor Day) shall be paid at double the hourly rate. All hours on Labor Day shall be paid at four times the hourly rate.
- If any other craft employed by the same contractor, or a subcontractor thereof, receives double time in lieu of time and one-half, then the Boilermaker shall receive double time in lieu of time and one-half.
- For "Municipal Water Works" projects only, the following shall apply: Four 10 hour days may be worked Monday through

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Thursday at straight time. Friday may be used as a make-up day for a day lost to inclement weather, holiday or other conditions beyond the control of the employer. Overtime shall be paid for any hours that exceed 10 hours per day or 40 hours per week.

RECOGNIZED HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Boilermaker - Minor Repairs

PREVAILING WAGE RATE

	01/09/15
Foreman	W30.29 B16.17 T46.46
General Foreman	W30.79 B16.17 T46.96
Mechanic	W28.79 B16.17 T44.96

Expiration Date: 12/31/2015

Craft: Boilermaker - Minor Repairs

COMMENTS/NOTES

NOTE: These rates apply to MINOR REPAIR WORK ONLY (repair work in the field for which the contract amount does not exceed \$20,000.00).

OVERTIME:

Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays (except Labor Day) shall be paid at double the hourly rate. All hours on Labor Day shall be paid at four times the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Washington's Birthday, Good Friday, Memorial Day, July 4th, Labor Day, Presidential Election Day, Thanksgiving Day, day after Thanksgiving, Christmas Day. Saturday holidays observed the preceding Friday, Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Bricklayer, Stone Mason

PREVAILING WAGE RATE

	11/01/14	05/01/15	11/01/15
Deputy Foreman	W41.25 B29.01 T70.26	W0.00 B0.00 T71.01	W0.00 B0.00 T71.76
Foreman	W44.25 B29.01 T73.26	W0.00 B0.00 T74.01	W0.00 B0.00 T74.76
Journeyman	W38.25 B29.01 T67.26	W0.00 B0.00 T68.01	W0.00 B0.00 T68.76

Expiration Date: 04/30/2016

Craft: Bricklayer, Stone Mason

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	40%	50%	55%	60%	65%	70%	75%	80%		
Benefits	3.72	4.65	5.12	5.58	19.21	20.47	21.74	23.01		

Ratio of Apprentices to Journeymen - 1:5

Craft: Bricklayer, Stone Mason

COMMENTS/NOTES

The regular workday shall consist of 8 hours, between 6:00 AM and 4:30 PM.

SHIFT DIFFERENTIALS:

- When a 2 shift schedule (including a day shift) is established, the first, or day shift, shall be established on an 8 hour basis. The second shift shall be established on an 8 hour basis, and receive the regular rate plus 15%, inclusive of benefits.
- When a three shift schedule is established, the first shift shall be established on an 8 hour basis, the second shift on a 7.5 hour basis, and the third shift on a 7 hour basis. The first shift shall receive the regular hourly rate, the second shift shall receive the regular rate plus 15%, inclusive of benefits, and the third shift shall receive the regular rate plus 20%, inclusive of benefits.
- When there is no day shift, and a second or third shift is established, it shall be established on an 8 hour basis. The second shift shall receive the regular rate plus 15%, inclusive of benefits, and the third shift shall receive the regular rate plus 20%, inclusive of benefits.

OVERTIME:

- The first 2 hours in excess of 8 per day, or before or after the regular workday that are not shift work, Monday through Friday, shall be paid at time and one-half the regular rate, inclusive of benefits. Any additional overtime shall be paid at double the regular rate, inclusive of benefits. The first 10 hours on Saturday shall be paid at time and one-half the regular rate, inclusive of benefits. Any additional overtime shall be paid at double the regular rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.
- Saturday may be used as a make-up day for hours lost to inclement weather.
- When Bricklayers/Stone Masons work on Saturday with Laborers, and no other crafts are working on the project for the day, benefits may be paid at straight time. If other crafts are present, the applicable overtime rate for benefits shall be paid.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Carpenter

PREVAILING WAGE RATE

	11/01/14	05/01/15	11/01/15
Foreman	W50.30 B28.16 T78.46	W0.00 B0.00 T79.17	W0.00 B0.00 T80.42
Journeyman	W43.74 B24.49 T68.23	W0.00 B0.00 T69.48	W0.00 B0.00 T70.73

Expiration Date: 04/30/2016

Craft: Carpenter

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	40%	45%	50%	55%	60%	65%	70%	75%	85%	95%
Benefit	56% of	Appren	tice	Wage	Rate		for all	intervals		

Ratio of Apprentices to Journeymen - 1:4

Craft: Carpenter

COMMENTS/NOTES

FOREMAN REQUIREMENTS:

- When there are 2 or more Carpenters on a job, 1 shall be designated as a Foreman.
- When there are 21 or more Carpenters on a job, 2 shall be designated as Foremen.

The regular workday shall consist of 8 hours, starting between 7:00 AM and 9:00 AM.

SHIFT DIFFERENTIALS:

- When a 2 shift schedule (including a day shift) is established, the day shift shall be established on an 8 hour basis. The second shift shall be established on an 8 hour basis, and receive the regular rate plus 15%, inclusive of benefits.
- When a three shift schedule is established, the first shift shall be established on an 8 hour basis, the second shift on a 7.5 hour basis, and the third shift on a 7 hour basis. The first shift shall receive the regular hourly rate, the second shift shall receive the regular rate plus 15% and the third shift shall receive the regular rate plus 20%, inclusive of benefits.
- When there is no day shift, and a second or third shift is established, it shall be established on an 8 hour basis. The second shift shall receive the regular rate plus 15% and the third shift shall receive the regular rate plus 20%, inclusive of benefits.

OVERTIME:

- All hours in excess of 8 per day, or before or after an established shift that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the hourly rate, inclusive of benefits.
- Four 10-hour days may be worked, Monday to Thursday, at straight time. Friday may be used as a make-up day for a day lost due to inclement weather. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half the hourly rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Carpenter - Resilient Flooring

PREVAILING WAGE RATE

	11/01/14
Foreman	W50.30 B28.16 T78.46
Journeyman	W43.74 B24.49 T68.23

Expiration Date: 04/30/2015

Craft: Carpenter - Resilient Flooring

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	40%	45%	50%	55%	60%	65%	70%	75%	85%	95%
Benefit	56% of	Appren	tice	Wage	Rate		for all	intervals		

Ratio of Apprentices to Journeymen - *

* 1 apprentice shall be allowed to every 2 journeymen or major fraction thereof. No more than 3 apprentices on any one job or project.

Craft: Carpenter - Resilient Flooring

COMMENTS/NOTES

FOREMAN REQUIREMENTS:

- On any job where there are 4 or more Carpenters of Resilient Flooring, 1 must be designated a Foreman.

FOR SYNTHETIC TURF INSTALLATION ONLY:

- The rate shall be 90% of the wage and benefit rate.

The regular workday consists of 8 hours, starting between 6:00 AM and 9:00 AM.

SHIFT DIFFERENTIALS:

- When a 2 shift schedule (including a day shift) is established, the day shift, shall be established on an 8 hour basis. The second shift shall be established on an 8 hour basis, and receive the regular wage rate plus 15%.
- When a three shift schedule is established, the first shift shall be established on an 8 hour basis, the second shift on a 7.5 hour basis, and the third shift on a 7 hour basis. The first shift shall receive the regular wage rate, the second shift shall receive the regular wage rate plus 15% and the third shift shall receive the regular wage rate plus 20%.
- When there is no day shift, and a second or third shift is established, it shall be established on an 8 hour basis. The second shift shall receive the regular wage rate plus 15% and the third shift shall receive the regular wage rate plus 20%.

OVERTIME:

- Hours in excess of 8 per day or 40 per week, or before or after the regular workday, Monday through Friday, shall be paid at time and one-half the wage rate. Saturday may be used as a make-up day, at straight time, up to 8 hours, for hours lost to reasons beyond the control of the employer, up to a total of 40 hours per week; hours in excess of 8 on Saturday shall then be paid at time and one-half the wage rate. If Saturday is not a make-up day, all hours on Saturday shall be paid at time and one-half the wage rate. All hours on Sundays and holidays shall be paid at double the wage rate.
- Four 10-hour days may be worked, Monday to Thursday, at straight time. Friday may be used as a make-up day for hours lost to reasons beyond the control of the employer. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half the wage rate.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Cement Mason

PREVAILING WAGE RATE

See "Bricklayer, Stone Mason" Rates

Expiration Date:

Craft: Cement Mason

COMMENTS/NOTES

See "Bricklayer, Stone Mason" Rates

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Diver PREVAILING WAGE RATE

	11/14/14
Diver	W54.34 B41.57 T95.91
Tender	W42.38 B41.57 T83.95

Expiration Date: 04/30/2015

Craft: Diver COMMENTS/NOTES

NOTE: All dive crews must consist of a Tender, a Diver, and a standby Diver (standby Diver is the same rate as a Diver).

DEPTH & PENETRATION RATES: Divers shall be paid the following depth and penetration rates, in addition to the regular hourly rate, when applicable:

AIR DIVES:

0-59 feet: No additional wage
60-74 feet: + \$0.25 per foot
5-125 feet: + \$0.78 per foot
126-200 feet: + \$1.60 per foot

MIXED GAS DIVES:

0-74 feet: No additional wage
75-125 feet: + \$1.00 per foot
126-200 feet: + \$2.00 per foot

PENETRATION DIVES:

126-200 feet: + \$1.50 per foot
201-275 feet: + \$1.75 per foot
276-350 feet: + \$2.00 per foot
351-425 feet: + \$2.50 per foot

OVERTIME:

Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Presidential Election Day, Thanksgiving Day, Christmas Day. Veterans' Day may be switched with the day after Thanksgiving.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Dockbuilder

PREVAILING WAGE RATE

	11/14/14
Foreman	W48.99 B41.57 T90.56
Foreman (Concrete Form Work)	W48.99 B33.73 T82.72
Journeyman	W42.60 B41.57 T84.17
Journeyman (Concrete Form Work)	W42.60 B33.73 T76.33

Expiration Date: 04/30/2015

Craft: Dockbuilder

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
Yearly	17.04	21.30	27.69	34.08						
Benefit	28.42	for all	intervals		Concrete	Form Work	only -Ben.	= 23.03	for all	intervals

Ratio of Apprentices to Journeymen - *

* When there are 4 or fewer Dockbuilders on a job, no more than 1 may be an apprentice. When there are 5 or more Dockbuilders, there may be 1 apprentice for every 5 Dockbuilders.

Craft: Dockbuilder

COMMENTS/NOTES

CREOSOTE HANDLING:

When handling creosote products on land piledriving, floating marine construction, and construction of wharves, the worker shall receive an additional \$0.25 per hour.

HAZARDOUS WASTE WORK:

- Hazardous waste removal work on a state or federally designated hazardous waste site where Level A, B, or C personal protection is required: an additional 20% of the hourly rate, per hour.
- Hazardous waste removal work in Level D, or where personal protection is not required: an additional \$1.00 per hour.

CERTIFIED WELDER: When required on the job by the project owner, a Certified Welder shall receive an additional \$1.00 per hour.

FOREMAN REQUIREMENTS:

The first Dockbuilder on the job shall be designated a Foreman.

OVERTIME:

Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Presidential Election Day, Thanksgiving Day, Christmas Day. Veterans' Day may be switched with the day after Thanksgiving.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Drywall Finisher

PREVAILING WAGE RATE

	05/08/14
Foreman	W41.80 B21.60 T63.40
General Foreman	W43.70 B21.60 T65.30
Journeyman	W38.00 B21.60 T59.60

Expiration Date: 04/30/2015

Craft: Drywall Finisher

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
4 Months	30%	40%	50%	60%	70%	75%	80%	85%	90%	
Benefits	Intervals	1 to 3 =	8.85	Intervals	4 to 6 =	11.28	Intervals	7 to 9 =	14.45	

Ratio of Apprentices to Journeymen - 1:4

Craft: Drywall Finisher

COMMENTS/NOTES

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.
- When 3 shifts are worked, the second shift shall receive 8 hours pay for 7.5 hours of work, and the third shift shall receive 8 hours pay for 7 hours of work.
- Shift work must run for a minimum of 5 consecutive workdays.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the regular rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.
- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.

RECOGNIZED HOLIDAYS: New Year's Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Saturday holiday observed the preceding Friday. Sunday holiday observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Electrician

PREVAILING WAGE RATE

	06/02/14	06/01/15	05/31/16
Assistant General Foreman	W58.89 B36.51 T95.40	W59.99 B37.19 T97.18	W61.09 B37.88 T98.97
Cable Splicer, Foreman	W56.90 B35.28 T92.18	W57.96 B35.94 T93.90	W59.02 B36.59 T95.61
General Foreman, Journeyman on Radio Tower Work	W60.89 B37.75 T98.64	W62.02 B38.45 T100.47	W63.16 B39.16 T102.32
Journeyman	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87
Layout Man	W54.40 B33.73 T88.13	W55.42 B34.36 T89.78	W56.43 B34.99 T91.42

Expiration Date: 05/31/2017

Craft: Electrician

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
6 Months	35%	40%		Yearly	50%	60%	70%	80%		
Benefit =	62% of	Appren	tice	Wage	Rate					

Ratio of Apprentices to Journeymen - 2:3

Craft: Electrician

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM ON OR AFTER 6-4-12:

INTERVAL PERIOD AND RATES

Yearly 30% 40% 50% 60% 70%

Benefits 62% of Apprentice Wage Rate

THESE RATES ALSO APPLY TO THE FOLLOWING TYPES OF WORK:

- All fire and burglar alarm work.
- All fiber optic work.
- Teledata work in new construction or involving 16 instruments or more.
- All residential construction (single family homes and apartments) of 5 units or more. Note: fire walls alone are not a determining criteria.

HIGH WORK:

- 40 feet above ground/floor: +21% of the Total Rate
- Transmission towers, and Smokestacks: +21% of the Total Rate

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

FOREMAN REQUIREMENTS:

- On any job where there is only 1 Journeyman electrician, who lays out his or her own job from plans, that electrician shall receive the Foreman rate.
- On any job where there are 2 or more electricians, 1 shall be a Foreman.
- On all jobs, every 11 electricians shall have 1 designated a Foreman.
- On any job where there are 23 or more electricians, 1 shall be a General Foreman.
- On any job where there are 50 or more electricians, 1 shall be an Assistant General Foreman, and 1 shall be a General Foreman.

The regular workday is 8 hours, between 8:00 AM and 4:30 PM.

SHIFT DIFFERENTIAL:

- Shift work must run for a minimum of 5 consecutive workdays.
- 1st Shift (8:30 AM-4:30 PM)
- 2nd Shift (4:30 PM-12:30 AM) shall receive 8 hours pay for 7.5 hours of work, plus an additional 10% of the hourly rate, per hour, inclusive of benefits.
- 3rd Shift: (12:30 AM-8:00 AM) shall receive 8 hours pay for 7 hours of work, plus an additional 15% of the hourly rate, per hour, inclusive of benefits.

OVERTIME:

Hours before or after the regular workday, Monday through Friday, that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the hourly rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Electrician - Teledata (15 Instruments and Less)

PREVAILING WAGE RATE

	11/19/14	11/02/15	10/31/16
Master Tech./Gen. Foreman (31+ workers on job)	W52.46 B24.63 T77.09	W0.00 B0.00 T78.49	W0.00 B0.00 T79.99
Senior Tech./Asst. Gen. Foreman (21-30 workers on job)	W48.02 B22.54 T70.56	W0.00 B0.00 T71.96	W0.00 B0.00 T73.46
Technician A/Foreman (11-20 workers on job)	W46.00 B21.61 T67.61	W0.00 B0.00 T69.01	W0.00 B0.00 T70.51
Technician B/Working Foreman (4-10 workers on job)	W43.98 B20.66 T64.64	W0.00 B0.00 T66.04	W0.00 B0.00 T67.54
Technician C/Journeyman (1-3 workers on job)	W40.35 B18.95 T59.30	W0.00 B0.00 T60.70	W0.00 B0.00 T62.20

Expiration Date: 10/31/2017

Craft: Electrician - Teledata (15 Instruments and Less)

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
6 Months	45%	48%	53%	59%	66%	72%	79%	86%		
Benefits	8.52	9.09	10.44	11.18	12.50	13.64	14.97	16.29		

Ratio of Apprentices to Journeymen - 2:3

Craft: Electrician - Teledata (15 Instruments and Less)

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM ON OR BEFORE 11-3-14:

INTERVAL	PERIOD AND RATES							
6 Months	40%	43%	48%	54%	61%	67%	74%	81%
Benefits	7.58	8.15	9.09	10.23	11.57	12.70	14.02	15.36

NOTES:

- 1) These rates are for service, maintenance, moves and/or changes affecting 15 instruments or less. These rates may NOT be used for any new construction or any fiber optic work.
- 2) The number of workers on the jobsite is the determining factor for which Foreman category applies.

HIGH WORK:

40 feet above ground/floor: +20% of the Total Rate

The regular workday is 8 hours, between 8:00 AM and 4:30 PM.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

SHIFT DIFFERENTIAL:

- 2nd Shift (4:30 PM-12:30 AM) shall receive 8 hours pay for 7.5 hours of work, plus an additional 10% of the regular rate, per hour, inclusive of benefits.
- 3rd Shift: (12:30 AM-8:00 AM) shall receive 8 hours pay for 7 hours of work, plus an additional 15% of the regular rate, per hour, inclusive of benefits.

OVERTIME:

Hours before outside the regular workday, Monday through Friday, that are not shift work, and all hours on Saturdays shall be paid at time and one-half the regular rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Electrician - Teledata (16 Instruments & More)

PREVAILING WAGE RATE

See "Electrician" Rates

Expiration Date:

Craft: Electrician - Teledata (16 Instruments & More)

COMMENTS/NOTES

See ELECTRICIAN Rates

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Electrician- Outside Commercial

PREVAILING WAGE RATE

	06/02/14	06/01/15	05/31/16
Assistant General Foreman	W58.89 B36.32 T95.21	W59.99 B37.19 T97.18	W61.09 B37.88 T98.97
Cable Splicer	W56.90 B35.28 T92.18	W57.96 B35.94 T93.90	W59.02 B36.59 T95.61
Certified Lineman Welder	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87
Equipment Repairman	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87
Equipment Serviceman	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87
Foreman (1-10 Journeyman workers on job)	W56.90 B35.28 T92.18	W57.96 B35.94 T93.90	W59.02 B36.59 T95.61
General Foreman	W60.89 B37.75 T98.64	W62.02 B38.45 T100.47	W63.16 B39.16 T102.32
Groundman	W33.44 B20.73 T54.17	W34.06 B21.12 T55.18	W34.69 B21.51 T56.20
Journeyman- Layout Man	W54.40 B33.73 T88.13	W55.42 B34.36 T89.78	W56.43 B34.99 T91.42
Journeyman Lineman	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87
X-Ray Journeyman Technician	W49.91 B30.94 T80.85	W50.84 B31.52 T82.36	W51.77 B32.10 T83.87

Expiration Date: 05/31/2017

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Electrician- Outside Commercial

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	35%	40%	Yearly	50%	60%	70%	80%			
Benefits	62% of	Appren	tice	Wage	Rate					

Craft: Electrician- Outside Commercial

COMMENTS/NOTES

* FOR UTILITY WORK PLEASE SEE STATEWIDE RATES

The regular workday is 8 hours, between 8:00 AM and 4:30 PM.

HIGH WORK:

40 FEET ABOVE GROUND/FLOOR: +21% OF THE Total Rate.

Radio towers, Transmission towers and Smokestacks: +21% of the Total Rate.

FOREMAN REQUIREMENTS:

On any job where there is only 1 Journeyman electrician, who lays out his or her own job from plans, that electrician shall receive the Foreman rate.

On any job where there are 2 or more electricians, 1 shall be a Foreman.

On all jobs, every 11 electricians shall have 1 designated a Foreman.

On any job where there are 23 or more electricians, 1 shall be a General Foreman.

SHIFT DIFFERENTIALS:

2nd Shift (4:30 PM to 12:30 AM): 8 hrs. pay for 7.5 hrs. work + an additional 10% of the regular rate, inclusive of benefits.

3rd Shift (12:30 AM to 8:00 AM): 8 hrs. pay for 7 hrs. work + an additional 15% of the regular rate per hour, inclusive benefits.

OVERTIME:

Hours before or after the regular workday, Monday through Friday, that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate, inclusive of benefits. All hours on Sundays and Holidays shall be paid at double the hourly rate, inclusive of benefits.

RECOGNIZED HOLIDAYS:

New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day and Christmas Day. Sunday holidays will be observed the following Monday.

NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION

County - BERGEN

Craft: Electrician-Utility Work (North) PREVAILING WAGE RATE

Rates are located in the "Statewide" rate package

Expiration Date:

Craft: Electrician-Utility Work (North) APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	60%	65%	70%	75%	80%	85%	90%			
Benefits	62.5% of	Appren	tice	Wage	Rate	for all	intervals			

Craft: Electrician-Utility Work (North) COMMENTS/NOTES

Electrician-Utility Work (North) rates are located in the "Statewide" rate package.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Electrician-Utility Work (South)

PREVAILING WAGE RATE

Rates are located in the "Statewide" rate package

Expiration Date:

Craft: Electrician-Utility Work (South)

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	26.27	28.46	30.65	32.84	35.03	37.22	39.41			
Benefits	21.83	23.08	24.32	25.57	26.81	28.06	29.32			

Craft: Electrician-Utility Work (South)

COMMENTS/NOTES

Electrician-Utility Work (South) rates are located in the "Statewide" rate package.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Elevator Constructor

PREVAILING WAGE RATE

	03/20/14
Journeyman	W58.23 B29.76 T87.99

Expiration Date: 03/16/2015

Craft: Elevator Constructor

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	26.06	32.03	37.85	43.67						
Benefits	25.76	26.16	26.96	27.76						

Ratio of Apprentices to Journeymen - 1:1

Craft: Elevator Constructor

COMMENTS/NOTES

The regular workday shall consist of either 7 or 8 hours to be established at the beginning of the project, between 7:00 AM and 4:30 PM.

OVERTIME:

For all hours worked before or after the regular workday, Monday through Friday, and all hours on Saturday and Sunday, shall be paid at double the hourly rate. Holiday pay is one days wages (8 hours) plus double the hourly rate for all hours worked.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Saturday holidays shall be observed on the previous Friday and Sunday holidays shall be observed on the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Elevator Modernization & Service

PREVAILING WAGE RATE

	03/20/14
Journeyman	W46.00 B29.61 T75.61

Expiration Date: 03/16/2015

Craft: Elevator Modernization & Service

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	26.06	25.30	29.90	34.50						
Benefits	25.68	26.08	26.86	27.65						

Ratio of Apprentices to Journeymen - 1:1

Craft: Elevator Modernization & Service

COMMENTS/NOTES

MODERNIZATION (addition, replacement, refurbishing, relocation, or changes in design or appearance, of elevator equipment in existing buildings):

- The regular workday consists of 8 hours, between 7:00 AM and 4:30 PM.

- Overtime:

Hours in excess of 8 per day, or before or after the regular workday, Monday through Friday, and all hours on Saturday and Sunday shall be paid at time and one-half the hourly rate. Holiday pay is one days wages (8 hours) plus time and one-half the hourly rate for all hours worked.

SERVICE (repair or replacement of parts for the purpose of maintaining elevator equipment in good operating condition):

- The regular workday consists of 8 hours, between 6:00 AM and 6:00 PM.

- Overtime:

Hours in excess of 8 per day, or before or after the regular workday, Monday through Friday, and all hours on Saturday shall be paid at time and one-half the hourly rate. All hours on Sunday and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS (Modernization and Service): New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Saturday holidays shall be observed on the previous Friday and Sunday holidays shall be observed on the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Glazier

PREVAILING WAGE RATE

	06/03/14	05/01/15	05/01/16
Foreman	W45.61 B22.04 T67.65	W0.00 B0.00 T69.15	W0.00 B0.00 T70.65
General Foreman	W47.61 B22.28 T69.89	W0.00 B0.00 T71.39	W0.00 B0.00 T72.89
Journeyman	W41.61 B21.56 T63.17	W0.00 B0.00 T64.67	W0.00 B0.00 T66.17

Expiration Date: 04/30/2017

Craft: Glazier

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
4 Months	30%	40%	50%	60%	70%	75%	80%	85%	90%	
Benefits	Intervals	1 to 3 =	6.51	Intervals	4 to 6 =	9.33	Intervals	7 to 9 =	11.67	

Ratio of Apprentices to Journeymen - 1:4

Craft: Glazier

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM AS OF 5-1-14:

INTERVAL	PERIOD AND RATES							
6 Months	50%	55%	60%	65%	70%	75%	80%	90%
Benefits	8.10	8.10	10.34	10.34	11.51	11.51	14.62	14.62

Hazard/Height Pay: +\$1.00 per hour

FOREMAN REQUIREMENTS:

- When there are 4 or more Glaziers on a job, 1 must be designated a Foreman.
- When there are 15 or more Glaziers on a job, 1 must be designated a General Foreman.

The regular workday shall consist of 8 hours, between 7:00 AM and 5:30 PM, Monday to Friday.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.
- When 3 shifts are worked, the second shift shall receive 8 hours pay for 7.5 hours of work, and the third shift shall receive 8 hours pay for 7 hours of work.

OVERTIME:

Hours in excess of 8 per day, or before or after the regular workday Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the regular rate. All hours on Sundays and holidays shall be paid at double the regular

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

rate.

RECOGNIZED HOLIDAYS: New Year's Day, Memorial Day, July 4th, Labor Day, General Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Saturday holiday observed the preceding Friday. Sunday holiday observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Heat & Frost Insulator

PREVAILING WAGE RATE

	09/19/14
Foreman	W51.52 B28.42 T79.94
General Foreman	W54.07 B29.53 T83.60
Journeyman	W50.24 B27.86 T78.10

Expiration Date: 09/18/2015

Craft: Heat & Frost Insulator

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	23.27	27.59	33.35	39.16						
Benefits	16.96	20.03	21.99	23.76						

Ratio of Apprentices to Journeymen - 1:3

Craft: Heat & Frost Insulator

COMMENTS/NOTES

NOTE: These rates apply to the installing of insulation on hot and cold mechanical systems.

The regular workday shall be 8 hours between 8:00 AM and 4:30 PM.

SHIFT DIFFERENTIAL:

- Shift work must run for a minimum of 5 consecutive workdays.
- Second Shift shall work 7.5 hours and receive 8 hours pay, at the regular rate, plus 25% per hour.
- Third Shift shall work 7 hours and receive 8 hours pay, at the regular rate, plus 30% per hour.

OVERTIME:

The first 2 hours in excess of 8 per day, hours outside of the regular workday Monday through Friday that are not shift work, and the first 10 hours on Saturday, shall be paid at time and one-half the regular rate, inclusive of benefits. All hours in excess of 10 per day, and all hours on Sunday and holidays (except Labor Day) shall be paid at double the regular rate, inclusive of benefits. All hours on Labor Day shall be paid at triple the regular rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Presidential Election Day, Thanksgiving Day and Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Heat & Frost Insulator - Asbestos Worker

PREVAILING WAGE RATE

	09/19/14
Asbestos Worker/Firestop	W25.68 B9.25 T34.93
Foreman	W51.52 B28.42 T79.94

Expiration Date: 09/18/2015

Craft: Heat & Frost Insulator - Asbestos Worker

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	SEE	HEAT &	FROST	INSULAT OR						

Ratio of Apprentices to Journeymen - 1:3

Craft: Heat & Frost Insulator - Asbestos Worker

COMMENTS/NOTES

NOTE: These rates apply only to the removal of insulation materials/asbestos from mechanical systems, including containment erection and demolition, and placing material in appropriate containers.

The regular workday shall be 8 hours between 8:00 AM and 4:30 PM.

SHIFT DIFFERENTIALS:

- Shift work must run for a minimum of 5 consecutive workdays.
- The second shift shall work 7.5 hours and receive 8 hours pay at the regular rate, plus 25% per hour.
- The third shift shall work 7 hours and receive 8 hours pay at the regular rate, plus 30% per hour.

OVERTIME: The first 2 hours in excess of 8 per day, hours outside of the regular workday Monday through Friday that are not shift work, and the first 10 hours on Saturday, shall be paid at time and one-half the regular rate, inclusive of benefits. All hours in excess of 10 per day, and all hours on Sunday and holidays (except Labor Day) shall be paid at double the regular rate, inclusive of benefits. All hours on Labor Day shall be paid at triple the regular rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Presidential Election Day, Thanksgiving Day and Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Ironworker

PREVAILING WAGE RATE

	07/01/14
Rod Foreman	W40.74 B41.52 T82.26
Rod Journeyman	W37.74 B41.52 T79.26
Structural Foreman	W43.79 B41.52 T85.31
Structural Journeyman	W40.79 B41.52 T82.31

Expiration Date: 06/30/2015

Craft: Ironworker

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
6 Months	50%	60%		Yearly	70%	80%	90%			

Ratio of Apprentices to Journeymen - 1:4

Craft: Ironworker

COMMENTS/NOTES

HAZARDOUS WASTE WORK: On hazardous waste removal work on a state or federally designated hazardous waste site where the Ironworker is required to wear Level A,B, or C personal protection: + \$3.00 per hour

The regular workday consists of 8 hours between 6:00 AM and 4:30 PM.

FOREMAN REQUIREMENTS:

When there are 2 or more Ironworkers on a job, 1 shall be designated a Foreman.

SHIFT DIFFERENTIALS:

- When a 2 shift schedule is established, the first, or day shift , shall be established on an 8 hour basis .The second shift shall be established on an 8 hour basis, and receive the regular rate plus 15%.
- When a three shift schedule is established, the first shift shall be established on an 8 hour basis, the second shift on a 7.5 hour basis, and the third shift on a 7 hour basis. The first shift shall receive the regular hourly rate, the second shift shall receive the regular rate plus 15%, and the third shift shall receive the regular rate plus 20%.
- When there is no day shift, and a second or third shift is established, it shall be established on an 8 hour basis.
- When an irregular shift is established for 5 consecutive days, the rate shall be paid at the regular rate and benefit rate , with no wage premium included. When an irregular shift is established for less than 5 days, the rate shall be paid at the regular rate plus 15%.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

OVERTIME:

- All hours in excess of 8 per day, or before or after an established shift that are not shift work, and all hours on Saturday, shall be paid at time and one-half the regular rate, inclusive of benefits. All hours on Sunday and holidays shall be paid at double the hourly rate, inclusive of benefits. Saturday may be used as a make-up day for a day lost to inclement weather. If Saturday is not a make-up day, all hours on Saturday shall be paid at time and one-half the hourly rate, inclusive of benefits.
- Four 10-hour days may be worked, Monday to Thursday, at straight time. Friday may be used as a make-up day for a day lost to inclement weather. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half the hourly rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Laborer - Asbestos & Hazardous Waste Removal

PREVAILING WAGE RATE

	12/17/14
Foreman	W38.00 B16.20 T54.20
Journeyman (Handler)	W36.00 B16.20 T52.20

Expiration Date: 07/31/2015

Craft: Laborer - Asbestos & Hazardous Waste Removal

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	27.96	28.66	29.72	31.84						
Benefit	16.15	for	all	intervals						

Ratio of Apprentices to Journeymen - *

* Ratio of apprentices to journeymen shall not be more than one apprentice for the first journeyman and no more than one (1) apprentice for each additional three (3) journeymen.

Craft: Laborer - Asbestos & Hazardous Waste Removal

COMMENTS/NOTES

NOTE: These rates apply to work in connection with Asbestos, Radiation, Hazardous Waste, Lead, Chemical, Biological, Mold Remediation and Abatement.

The regular workday shall be 8 hours between 6:00 AM and 6:00 PM.

OVERTIME:

- Hours in excess of 8 per day, Monday through Saturday, and all hours on Sunday and holidays shall be paid at time and one-half the regular rate.
- When the owner (Public Body) mandates that work is to be performed on Sunday, those hours may be worked at straight time, up to 8 hours per day, up to 40 hours per week.
- Benefits on ALL overtime hours shall be paid at straight time.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Good Friday, Easter, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Laborer - Building

PREVAILING WAGE RATE

	05/13/14
Class A Journeyman	W30.65 B23.37 T54.02
Class B Journeyman	W30.15 B23.37 T53.52
Class C Journeyman	W25.63 B23.37 T49.00
Foreman	W34.48 B23.37 T57.85
General Foreman	W38.31 B23.37 T61.68

Expiration Date: 04/30/2015

Craft: Laborer - Building

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
6 Months	60%	70%	80%	90%						
Benefit	20.92	20.92	20.92	20.92						

Ratio of Apprentices to Journeymen - *

* Ratio of apprentices to journeymen shall not be more than one apprentice for the first journeyman and no more than one (1) apprentice for each additional three (3) journeymen.

Craft: Laborer - Building

COMMENTS/NOTES

CLASS A: Specialist laborer including mason tender or concrete pour crew; scaffold builder (scaffolds up to 14 feet in height); operator of forklifts, Bobcats (or equivalent machinery), jack hammers, tampers, motorized tampers and compactors, vibrators, street cleaning machines, hydro demolition equipment, riding motor buggies, conveyors, burners; and nozzlemen on gunite work.

CLASS B: Basic laborer - includes all laborer work not listed in Class A or Class C.

CLASS C: Janitorial-type light clean-up work associated with the TURNOVER of a project, or part of a project, to the owner. All other clean-up work is Class B.

The regular workday shall be 8 hours between 6:00 AM and 6:00 PM.

SHIFT DIFFERENTIALS:

- Shift work must run for a minimum of 5 consecutive workdays.

- When a 2-shift schedule is worked, including a day shift, both shifts shall be established on the basis of 8 hours pay for 8 hours worked. The second shift shall receive the regular rate plus an additional 10%.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

- When a 3-shift schedule is worked, the day shift shall be established on the basis of 8 hours pay for 8 hours worked, the second shift shall be established on the basis of 8 hours pay for 7.5 hours worked, and the third shift shall be established on the basis of 8 hours pay for 7 hours worked. The day shift shall receive the regular rate, the second shift shall receive the regular rate plus an additional 10%, and the third shift shall receive the regular rate plus an additional 15%.
- When a second or third shift is worked with no day shift, the second or third shift shall be established on the basis of 8 hours pay for 8 hours worked. The second shift shall receive the regular rate plus an additional 10%, and the third shift shall receive the regular rate plus an additional 15%.

OVERTIME:

- Hours in excess of 8 per day, or outside the regular workday that are not shift work, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the regular rate. All hours on Sundays and holidays shall be paid at double the regular rate.
- Four 10-hour days may be worked Monday to Thursday, at straight time, with Friday used a make-up day for a day lost to inclement weather. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half the regular rate.
- Benefits on ALL overtime hours shall be paid at time and one-half.

RECOGNIZED HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Laborer - Heavy & General

PREVAILING WAGE RATE

Rates are located in the
"Statewide" rate package

Expiration Date:

Craft: Laborer - Heavy & General

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	60%	70%	80%	90%						
1000 Hours	60%	70%	80%	90%						
Benefit	16.28	for	all	intervals						

Ratio of Apprentices to Journeymen - *

* No more than 1 apprentice for the first journeyman and no more than 1 apprentice for each additional 3 journeymen.

Craft: Laborer - Heavy & General

COMMENTS/NOTES

Heavy & General Laborer rates are located in the "Statewide" rate package.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Millwright

PREVAILING WAGE RATE

	11/01/14	05/01/15	11/01/15
Foreman	W51.13 B28.69 T79.82	W0.00 B0.00 T80.59	W0.00 B0.00 T81.84
Journeyman	W44.46 B24.95 T69.41	W0.00 B0.00 T70.70	W0.00 B0.00 T71.95

Expiration Date: 04/30/2016

Craft: Millwright

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	40%	45%	50%	55%	60%	65%	70%	75%	85%	95%
Benefits	56% of	Appren	tice	Wage	Rate	for all	intervals	+ \$.05		

Ratio of Apprentices to Journeymen - 1:4

Craft: Millwright

COMMENTS/NOTES

FOREMAN REQUIREMENTS:

- When there are 2 or more Millwrights on a job, 1 shall be designated as a Foreman.
- When there are 21 or more Millwrights on a job, 2 shall be designated as Foremen.

The regular workday shall consist of 8 hours, starting between 7:00 AM and 9:00 AM.

SHIFT DIFFERENTIALS:

- When a 2 shift schedule (including a day shift) is established, the day shift shall be established on an 8 hour basis. The second shift shall be established on an 8 hour basis, and receive the regular rate plus 15%, inclusive of benefits.
- When a three shift schedule is established, the first shift shall be established on an 8 hour basis, the second shift on a 7.5 hour basis, and the third shift on a 7 hour basis. The first shift shall receive the regular hourly rate, the second shift shall receive the regular rate plus 15% and the third shift shall receive the regular rate plus 20%, inclusive of benefits.
- When there is no day shift, and a second or third shift is established, it shall be established on an 8 hour basis. The second shift shall receive the regular rate plus 15% and the third shift shall receive the regular rate plus 20%, inclusive of benefits.

OVERTIME:

- All hours in excess of 8 per day, or before or after an established shift that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the hourly rate, inclusive of benefits.
- Four 10-hour days may be worked, Monday to Thursday, at straight time. Friday may be used as a make-up day for a day lost due to inclement weather. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half the hourly rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Operating Engineer

PREVAILING WAGE RATE

Rates are located in the
"Statewide" rate package

Expiration Date:

Craft: Operating Engineer

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	60%	70%	80%	90%						

Ratio of Apprentices to Journeymen - *

* 1 apprentice for each piece of heavy equipment. At least 10 pieces of heavy equipment or a minimum of 5 Operating Engineers must be on site.

Craft: Operating Engineer

COMMENTS/NOTES

Operating Engineer rates are located in the "Statewide" rate package.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Operating Engineer - Field Engineer

PREVAILING WAGE RATE

Rates are located in the
"Statewide" rate package

Expiration Date:

Craft: Operating Engineer - Field Engineer

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	70%	75%	of Rod/	Chainman	Wage					
Yearly										
Yearly			80%	90%	Transit/	Instrument	man	Wage		

Ratio of Apprentices to Journeymen - *

* No more than 1 Field Engineer Apprentice per Survey Crew.

Craft: Operating Engineer - Field Engineer

COMMENTS/NOTES

Operating Engineer - Field Engineer rates are located in the "Statewide" rate package.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter - Bridges

PREVAILING WAGE RATE

	05/15/14
Foreman	W55.68 B24.12 T79.80
General Foreman	W58.18 B24.12 T82.30
Journeyman	W50.68 B24.12 T74.80

Expiration Date: 04/30/2015

Craft: Painter - Bridges

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
6 Months	50%	55 %			60%	65%		75%	85%	
Benefits	Intervals	1 to 2 =	8.88	Intervals	3 to 4 =	10.56	Intervals	5 to 6 =	12.23	

Ratio of Apprentices to Journeymen - 1 :4

Craft: Painter - Bridges

COMMENTS/NOTES

These rates apply to: All bridges that span waterways, roadways, railways and canyons. All tunnels, overpasses, viaducts and all appurtenances.

FOREMEN REQUIREMENTS:

- When there are 4 or more Painters on a job, 1 shall be designated a Foreman.
- When there are 15 or more Painters on a job, 1 shall be designated a General Foreman.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays and Sundays shall be paid at time and one-half the regular rate. All hours on holidays shall be paid at double the regular rate.
- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.
- Four 10-hour days may be worked, at straight time, Monday through Friday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Saturday holiday observed the preceding Friday. Sunday holiday observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter - Line Striping

PREVAILING WAGE RATE

	07/25/14
Foreman (Charge Person)	W35.45 B13.80 T49.25
Helper (1st Year)	W26.88 B13.71 T40.59
Helper (2nd Year)	W28.48 B13.74 T42.22
Helper (3rd Year)	W30.62 B13.75 T44.37
Journeyman	W34.95 B13.80 T48.75

Expiration Date: 06/30/2015

Craft: Painter - Line Striping

COMMENTS/NOTES

OVERTIME:

Hours in excess of 8 per day, Monday through Saturday, and all hours on Sundays and holidays shall be paid at time and one-half the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Veterans Day, Thanksgiving Day and Christmas Day. Veterans Day may be substituted for the day after Thanksgiving.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter - New Construction

PREVAILING WAGE RATE

	07/11/14
Foreman	W40.90 B21.34 T62.24
General Foreman	W44.67 B21.34 T66.01
Journeyman	W37.22 B21.34 T58.56

Expiration Date: 04/30/2015

Craft: Painter - New Construction

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
4 Months	30%	40%	50%	60%	70%	75%	80%	85%	90%	
Benefits	Intervals	1 to 3 =	8.00	Intervals	4 to 6 =	10.00	Intervals	7 to 9 =	11.00	

Ratio of Apprentices to Journeymen - 1:4

Craft: Painter - New Construction

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM ON 5-1-14:

INTERVAL	PERIOD AND RATES							
6 Months	40%	45%	55%	65%	70%	75%	80%	90%
Benefits	8.00	8.00	10.00	10.00	11.00	11.00	14.00	14.00

Spraying, sandblasting, lead abatement, work on tanks or stacks, work performed above 3 stories or 30 feet in height, or using swing scaffolds requires an additional 10% of the wage rate.

FOREMEN REQUIREMENTS:

- When there are 4 or more Painters on a job, 1 shall be designated a Foreman.
- When there are 15 or more Painters on a job, 1 shall be designated a General Foreman.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, or before or after the regular workday, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the regular rate. All hours on Sundays and holidays shall be paid at double the regular

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

rate.

- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.
- Four 10-hour days may be worked, at straight time, Monday through Friday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, General Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter - Repainting

PREVAILING WAGE RATE

	07/11/14
Foreman	W31.41 B17.95 T49.36
General Foreman	W34.27 B17.95 T52.22
Journeyman	W28.56 B17.95 T46.51

Expiration Date: 04/30/2015

Craft: Painter - Repainting

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	SEE	PAINTER	NEW	CONSTR	TION					
				UC						

Ratio of Apprentices to Journeymen - 1:4

Craft: Painter - Repainting

COMMENTS/NOTES

NOTE: These rates may only be used on jobs where no major alterations occur, and where not more than 3 other trades are present on the job, but may NOT, under any circumstances, be used for work on bridges, stacks, elevated tank, or generating stations.

Spraying, sandblasting, lead abatement, work on tanks or stacks, work performed above 3 stories or 30 feet in height, or using swing scaffolds requires an additional 10% of the wage rate.

FOREMEN REQUIREMENTS:

- When there are 4 or more Painters on a job, 1 shall be designated a Foreman.
- When there are 15 or more Painters on a job, 1 shall be designated a General Foreman.

OVERTIME:

- Hours in excess of 8 per day and 40 per week shall be paid at time and one-half the regular rate.
- Four 10-hour days may be worked, at straight time, Monday through Sunday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, General Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter- Containment

PREVAILING WAGE RATE

	05/15/14
Journeyman	W31.37 B22.42 T53.79

Expiration Date: 04/30/2015

Craft: Painter- Containment

COMMENTS/NOTES

NOTE: These rates shall require no painting, but used in a supporting capacity only, such as wrapping, boxing, fencing, etc. on new tanks and structural steel only.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays and Sundays shall be paid at time and one-half the regular rate. All hours on holidays shall be paid at double the regular rate..

RECOGNIZED HOLIDAYS: New Year's Day President's Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Saturday holiday observed the preceding Friday. Sunday holiday observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter- Structural Steel and Tanks (New Construction)

PREVAILING WAGE RATE

	05/15/14
Foreman	W44.21 B22.42 T66.63
General Foreman	W46.71 B22.42 T69.13
Journeyman	W39.21 B22.42 T61.63

Expiration Date: 04/30/2015

Craft: Painter- Structural Steel and Tanks (New Construction)

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	SEE	PAINTER	BRIDGES							

Craft: Painter- Structural Steel and Tanks (New Construction)

COMMENTS/NOTES

These rates apply to: All work in nuclear plants, on towers, on steeples, on dams, on hangers and open steel whether new or repaint. All new work in refineries, tank farms, water/sewerage treatment facilities and on pipelines, and tanks, including all elevated and water tanks, tank interiors and repaint of ground tanks over sixty (60) feet in height.

FOREMEN REQUIREMENTS:

- When there are 4 or more Painters on a job, 1 shall be designated a Foreman.
- When there are 15 or more Painters on a job, 1 shall be designated a General Foreman.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays and Sundays shall be paid at time and one-half the regular rate. All hours on holidays shall be paid at double the regular rate.
- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.
- Four 10-hour days may be worked, at straight time, Monday through Friday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Saturday holiday observed the preceding Friday. Sunday holiday observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Painter- Structural Steel and Tanks (Repaint)

PREVAILING WAGE RATE

	05/15/14
Foreman	W35.31 B18.85 T54.16
General Foreman	W37.81 B18.85 T56.66
Journeyman	W30.31 B18.85 T49.16

Expiration Date: 04/30/2015

Craft: Painter- Structural Steel and Tanks (Repaint)

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	SEE	PAINTER	BRIDGES							

Craft: Painter- Structural Steel and Tanks (Repaint)

COMMENTS/NOTES

These rates apply to: All repaint work in refineries, tank farms, water/sewerage treatment facilities and on pipelines and repainting of all other tanks.

FOREMEN REQUIREMENTS:

- When there are 4 or more Painters on a job, 1 shall be designated a Foreman.
- When there are 15 or more Painters on a job, 1 shall be designated a General Foreman.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays and Sundays shall be paid at time and one-half the regular rate. All hours on holidays shall be paid at double the regular rate.
- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.
- Four 10-hour days may be worked, at straight time, Monday through Friday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Paperhanger - New Construction

PREVAILING WAGE RATE

	07/11/14
Foreman	W41.93 B21.44 T63.37
Journeyman	W38.12 B21.44 T59.56

Expiration Date: 04/30/2015

Craft: Paperhanger - New Construction

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
4 Months	30 %	40%	50%	60%	70%	75%	80%	85%	90%	
Benefits	Intervals	1 to 3 =	8.00	Intervals	4 to 6 =	10.00	Intervals	7 to 9 =	11.00	

Ratio of Apprentices to Journeymen - 1:4

Craft: Paperhanger - New Construction

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES ENTERING PROGRAM ON 5-1-14:

INTERVAL	PERIOD AND RATES							
6 Months	40%	45%	55%	65%	70%	75%	80%	90%
Benefits	8.00	8.00	10.00	10.00	11.00	11.00	14.00	14.00

FOREMEN REQUIREMENTS:

- When there are 4 or more Paperhangers on a job, 1 shall be designated a Foreman.

The regular workday shall consist of 8 hours between 7:00 AM and 5:30 PM.

SHIFT DIFFERENTIALS:

- The second shift shall receive an additional 10% of the hourly rate, per hour, and the third shift shall receive an additional 15% of the hourly rate, per hour.

OVERTIME:

- Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the regular rate. All hours on Sundays and holidays shall be paid at double the regular rate.
- Saturday or Sunday may be used to make up a day lost to inclement weather, at straight time.
- Four 10-hour days may be worked, at straight time, Monday through Friday.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day, July 4th, Labor Day, General Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - **BERGEN**

Craft: Paperhanger - Renovation

PREVAILING WAGE RATE

	07/11/14
Foreman	W32.21 B18.03 T50.24
Journeyman	W29.28 B18.03 T47.31

Expiration Date: 04/30/2015

Craft: Paperhanger - Renovation

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
	SEE	PAPER-	HANGER	NEW	CONSTR	TION				
					UC					

Ratio of Apprentices to Journeymen - 1:4

Craft: Paperhanger - Renovation

COMMENTS/NOTES

NOTE: These rates may only be used on jobs where no major alterations occur, and where not more than 3 other trades are present on the job, but may NOT, under any circumstances, be used for work on bridges, stacks, elevated tanks, or generating stations.

FOREMEN REQUIREMENTS:

- When there are 4 or more Paperhangers on a job, 1 shall be designated a Foreman.

OVERTIME:

- Hours in excess of 8 per day and 40 per week shall be paid at time and one-half the regular rate.
- Four 10-hour days may be worked, at straight time, Monday through Sunday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Pipefitter

PREVAILING WAGE RATE

	07/11/14
Foreman	W52.24 B30.59 T82.83
Journeyman	W48.76 B30.59 T79.35

Expiration Date: 04/30/2015

Craft: Pipefitter

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	*	*	*	*	39.01					
Benefit	*	*	*	*	27.34					

Ratio of Apprentices to Journeymen - 1:5

Craft: Pipefitter

COMMENTS/NOTES

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES WHO ENTERED PROGRAM AFTER 5-1-10:

Interval	Period and Rates				
Yearly	17.07	21.94	26.82	31.69	39.01
Benefits	20.04	21.65	23.29	24.90	27.34

FOREMAN REQUIREMENTS:

- The first Pipefitter on a job must be a Foreman.
- There must be a Foreman for every 6 Pipefitters on a job, not counting apprentices.

The regular workday shall be 8 hours, between 8:00 AM and 4:30 PM.

SHIFT DIFFERENTIALS:

- Shift work must run for a minimum of 5 consecutive workdays.
- 2nd Shift (between 4:00PM and 12:00AM) shall work 7.5 hours and receive 8 hours pay at the hourly rate, plus 25% per hour.
- 3rd Shift (between 12:00AM and 8:00AM) shall work 7 hours and receive 8 hours pay at the hourly rate, plus 30% per hour.

OVERTIME:

- The first 2 hours in excess of 8 per day or outside of the regular workday, Monday through Friday, and the first 8 hours on Saturdays shall be paid at time and one-half the regular rate, inclusive of benefits. Hours in excess of 10 per day, Monday through Friday, in excess of 8 on Saturdays, and all hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.
- Four 10-hour days may be worked at straight time, Monday through Thursday, with Friday used as a make-up day for a day lost to inclement weather. If Friday is not a make-up day, the first 10 hours on Friday shall be paid at time and one-half, inclusive of benefits. All remaining overtime shall be paid as stated above.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

SHIFT DIFFERENTIALS - SERVICE & MAINTENANCE WORK:

- The 2nd shift shall work 7.5 hours and receive 8 hours pay at the hourly rate, plus 10% per hour.
- The 3rd shift shall work 7 hours and receive 8 hours pay at the hourly rate, plus 15% per hour.

OVERTIME - SERVICE & MAINTENANCE WORK:

- All hours outside of the regular workday, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half, inclusive of benefits. All hours on Sundays and holidays shall be paid at double the hourly rate, inclusive of benefits.

NOTE: Service and Maintenance work is work to repair, restore, or improve the efficiency of existing facilities. This does NOT apply to ANY new construction.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, and Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Plasterer

PREVAILING WAGE RATE

See Bricklayer, Stone Mason Rates

Expiration Date:

Craft: Plasterer

COMMENTS/NOTES

See BRICKLAYER, STONE MASON Rates

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Plumber PREVAILING WAGE RATE

	05/01/14	05/01/15
Foreman	W53.31 B30.99 T84.30	W0.00 B0.00 T86.18
General Foreman	W56.76 B30.99 T87.75	W0.00 B0.00 T89.55
Journeyman	W49.36 B30.99 T80.35	W0.00 B0.00 T82.30

Expiration Date: 04/30/2016

Craft: Plumber APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	30%	45%	55%	65%	75%					
Benefit	11.89	17.51	19.04	20.06	22.13					

Ratio of Apprentices to Journeymen - *

* Employers may employ 1 apprentice on any job where 1 or 2 journeymen are employed. Thereafter, 1 apprentice may be employed for every 4 journeymen.

Craft: Plumber COMMENTS/NOTES

FOREMAN REQUIREMENTS:

- On any job having 2 or more Plumbers, 1 must be designated a Foreman.
- On any job having 9 or more Plumbers, 2 shall be designated as Foremen.

The regular workday shall consist of 8 hours between 7:00 AM and 4:30 PM.

SHIFT DIFFERENTIALS:

- Shift work must continue for a minimum of 5 consecutive workdays.
- When two shifts are worked, the second shift shall work 7.5 hours and receive 8 hours pay, at a rate equal to the hourly rate plus 10%, inclusive of benefits.
- When a third shift is worked, the third shift shall work 7 hours and receive 8 hours pay, at a rate equal to the hourly rate plus 15%, inclusive of benefits.

OVERTIME:

- All hours in excess of 8 per day, or before or after the regular workday that are not shift work, Monday through Friday, and all hours Saturday, shall be paid at time and one-half the regular rate, inclusive of benefits. All hours on Sunday and holidays shall be paid at double the hourly rate, inclusive of benefits.
- Four 10-hour days may be worked, Monday to Thursday, at straight time. Friday may be used as a make-up day for a day lost due to inclement weather. If Friday is not a make-up day, all hours on Friday shall be paid at time and one-half, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day, July 4th, Labor Day, Presidential Election

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Roofer

PREVAILING WAGE RATE

	06/01/14
Foreman	W37.35 B19.88 T57.23
Journeyman	W35.35 B19.88 T55.23
Mop Man	W36.10 B19.88 T55.98
Sub-Foreman	W35.85 B19.88 T55.73

Expiration Date: 05/31/2015

Craft: Roofer

APPRENTICE RATE SCHEDULE

<u>INTERVAL</u>	<u>PERIOD AND RATES</u>									
6 months	43%	50%	57%	64%	71%	78%	85%	92%		
Benefit	2.83	for all	intervals							

Ratio of Apprentices to Journeymen - *

* Re-roofing work: 1:1 New roofing work: 1:4

Craft: Roofer

COMMENTS/NOTES

NOTES:

- Working with pitch (including on tear-offs): + \$1.00 per hour
- Working with asbestos: + \$1.00 per hour
- On Solar projects (with no roofing work included): \$1.00 less per hour.

FOREMAN REQUIREMENTS:

- When there is only 1 roofer on the project, he/she shall be designated a "Sub-Foreman".
- When 2 or more roofers are on the project, 1 shall be designated a "Foreman".
- When 6 or more roofers are on the project, 1 shall be designated a "Foreman", and there shall be 1 "Sub-Foreman" for every 6 roofers (or fraction thereof).

OVERTIME:

Hours in excess of 8 per day, Monday through Friday, and all hours on Saturdays, Sundays, and holidays shall be paid at time and one-half the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Memorial Day, July 4th, Labor Day, Veterans' Day, Presidential Election Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Sheet Metal Sign Installation

PREVAILING WAGE RATE

	10/02/14
Foreman	W32.03 B27.97 T60.00
Journeyman	W30.78 B27.97 T58.75

Expiration Date: 03/31/2015

Craft: Sheet Metal Sign Installation

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
1000 hours	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%
Benefits	9.92	11.10	12.31	13.49	15.07	16.29	17.53	18.75	19.98	21.20

Ratio of Apprentices to Journeymen - 1:3

Craft: Sheet Metal Sign Installation

COMMENTS/NOTES

FOREMAN REQUIREMENT:

When there are 6 or more Sheet Metal Sign Installers on a job, 1 shall be designated a Foreman.

The regular workday consists of 8 hours, between 7:00 AM and 3:30 PM.

OVERTIME:

Hours before or after the regular workday, Monday through Friday, and all hours worked on Saturday shall be paid at time and one-half the hourly rate. All hours on Sunday and holidays shall be paid at double the hourly rate.

Four (4) 10 hour days may be worked, Monday through Friday, at straight time, for projects lasting at least one week in duration. The fifth day may be used as a make-up day at straight time for a day lost due to inclement weather. However, if the fifth day is not a make-up day, all hours worked will be paid at time and one-half the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Saturday holidays observed the preceding Friday, Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Sheet Metal Worker

PREVAILING WAGE RATE

	06/09/14
Foreman	W47.13 B35.84 T82.97
General Foreman	W48.13 B35.84 T83.97
Journeyman	W44.63 B35.84 T80.47

Expiration Date: 05/31/2015

Craft: Sheet Metal Worker

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
Yearly	35%	45%	55%	65%	of	Journey	man	Wage	Rate	
Benefit	35%	45%	55%	65%	of	Journey	man	Benefit	Rate	

Ratio of Apprentices to Journeymen - 1:4

Craft: Sheet Metal Worker

COMMENTS/NOTES

FOREMAN REQUIREMENTS:

- When there are 2 or more Sheet Metal Workers on a project, 1 must be designated a Foreman.
- When there are 17 or more Sheet Metal Workers on a project, 1 must be designated a General Foreman.
- When there is only 1 Sheet Metal Worker (1 Journeyman) on a project, he/she shall receive \$1.00 more than the regular Journeyman's rate.

The regular workday is 8 hours between 7:00 AM and 4:30 PM.

SHIFT DIFFERENTIAL:

- 2nd Shift (3:30 PM - 12:00 AM) : +17% of regular hourly rate
- Shift work must run for a minimum of 5 consecutive workdays.

OVERTIME:

- Hours in excess of 8 per day, or before or after the regular workday, that are not shift work, and the first 10 hours on Saturdays shall be paid at time and one-half of the regular rate, inclusive of benefits. Hours in excess of 10 per day on Saturday, and all hours on Sundays and holidays shall be at double the regular rate, inclusive of benefits.
- Four 10-hour days may be worked, Monday through Friday, at straight time, with hours in excess of 10 per day, and hours in excess of 40 per week paid at the overtime rates listed above.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Sprinkler Fitter

PREVAILING WAGE RATE

	07/01/14	07/01/15
Foreman	W60.78 B23.87 T84.65	W0.00 B0.00 T86.65
General Foreman	W63.59 B23.87 T87.46	W0.00 B0.00 T89.46
Journeyman	W56.78 B23.87 T80.65	W0.00 B0.00 T82.65

Expiration Date: 06/30/2016

Craft: Sprinkler Fitter

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
1000 hours	9.50	11.25	28.39	31.23	34.07	36.91	39.75	42.59	45.42	48.26
Benefits	10.12	10.12	19.87	19.87	19.87	19.87	Intervals	7 to 10	Jourymn	Ben.

Ratio of Apprentices to Journeymen - 1:3

APPRENTICE RATE SCHEDULE FOR THOSE APPRENTICES REGISTERED AS OF 7-1-13:

INTERVAL	PERIOD AND RATES									
1000 hours	14.20	17.03	22.71	25.55	31.23	34.07	39.75	42.59	48.26	51.10
Benefits	10.12	10.12	19.87	19.87	19.87	19.87	Intervals 7 to 10 receive Journeyman Ben.			

Craft: Sprinkler Fitter

COMMENTS/NOTES

The regular workday consists of 8 consecutive hours between 6:00 AM and 4:30 PM.

FOREMAN REQUIREMENTS:

- The first Sprinkler Fitter on the job must be designated a Foreman.
- On any job having 12 or more Sprinkler Fitters, one must be designated a General Foreman.

SHIFT DIFFERENTIALS:

- Shift work must run for a minimum of 2 consecutive workdays.
- 2nd and 3rd shift shall receive an additional 15% of the regular rate, per hour.
- Any "off hours" shift starting at 8:00 PM or later shall receive an additional 25% of the regular rate, per hour.

OVERTIME:

The first 2 hours in excess of 8 per day, after the regular workday that are not shift work, Monday through Friday, shall be paid at time and one-half the regular rate. Hours worked in excess of 10 per day, Monday through Friday, and all hours on Saturday, Sunday and holidays, shall be paid double the regular rate.

Four 10 hour days may be worked, Monday through Thursday, at straight-time.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Tile Finisher-Marble

PREVAILING WAGE RATE

	01/01/15	07/01/15	01/01/16	07/01/16
Finisher	W46.58 B28.17 T74.75	W47.47 B28.17 T75.64	W48.37 B28.17 T76.54	W49.44 B28.17 T77.61

Expiration Date: 12/31/2016

Craft: Tile Finisher-Marble

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
750 Hours	50%	55%	65%	70%	75%	85%	90%	95%		

Ratio of Apprentices to Journeymen - 1:4

Craft: Tile Finisher-Marble

COMMENTS/NOTES

OVERTIME:

Hours in excess of 7 per day, Monday through Friday, and the first 7 hours on Saturdays shall be paid at time and one half the regular rate, inclusive of benefits. Hours in excess of 7 on Saturdays and all hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Tile Setter - Ceramic

PREVAILING WAGE RATE

	12/06/14	06/06/15	12/05/15	06/04/16	12/03/16
Finisher	W42.10 B27.07 T69.17	W42.92 B27.07 T69.99	W43.74 B27.07 T70.81	W44.56 B27.07 T71.63	W45.38 B27.07 T72.45
Setter	W54.04 B29.96 T84.00	W55.17 B29.96 T85.13	W56.30 B29.96 T86.26	W57.43 B29.96 T87.39	W58.56 B29.96 T88.52

Expiration Date: 12/02/2016

Craft: Tile Setter - Ceramic

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
750 Hours	50%	55%	60%	65%	70%	75%	85%	95%	100%	

Ratio of Apprentices to Journeymen - 1:4

Craft: Tile Setter - Ceramic

COMMENTS/NOTES

OVERTIME:

Hours in excess of 7 per day, and the first 10 hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Saturdays after 10 hours shall be paid double the hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Tile Setter - Marble

PREVAILING WAGE RATE

	01/01/15	07/01/15	01/01/16	07/01/16
Tile Setter	W58.22 B28.39 T86.61	W59.46 B28.39 T87.85	W60.71 B28.39 T89.10	W62.16 B28.39 T90.55

Expiration Date: 12/31/2016

Craft: Tile Setter - Marble

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
750 Hours	50%	55%	65%	70%	75%	85%	90%	95%		

Ratio of Apprentices to Journeymen - 1.4

Craft: Tile Setter - Marble

COMMENTS/NOTES

OVERTIME:

Hours in excess of 7 per day, Monday through Friday, and the first 7 hours on Saturdays shall be paid at time and one-half the regular rate, inclusive of benefits. Hours in excess of 7 on Saturdays, and all hours on Sundays and holidays shall be paid at double the regular rate, inclusive of benefits.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Memorial Day, July 4th, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Tile Setter - Mosaic & Terrazzo

PREVAILING WAGE RATE

	01/01/15	07/01/15	01/01/16	07/01/16
Grinder or Assistant	W48.61 B31.79 T80.40	W49.76 B31.79 T81.55	W50.91 B31.79 T82.70	W52.06 B31.79 T83.85
Mechanic	W50.22 B31.80 T82.02	W51.37 B31.80 T83.17	W52.52 B31.80 T84.32	W53.67 B31.80 T85.47

Expiration Date: 12/31/2016

Craft: Tile Setter - Mosaic & Terrazzo

APPRENTICE RATE SCHEDULE

INTERVAL	PERIOD AND RATES									
750 Hours	50%	55%	65%	70%	75%	85%	90%	95%		

Ratio of Apprentices to Journeymen - 1:5

Craft: Tile Setter - Mosaic & Terrazzo

COMMENTS/NOTES

The regular workday consists of 7 hours, between 8:00 AM and 3:30 PM.

OVERTIME:

- Hours in excess of 7 per day, or before or after the regular workday, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Good Friday, Monday after Easter, Memorial Day, July 4th, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day and the day after, Christmas Day. Sunday holidays observed the following Monday.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Truck Driver

PREVAILING WAGE RATE

	12/01/14	05/01/15	11/01/15
Bucket, Utility, Pick-up, Fuel Delivery trucks	W33.90 B31.23 T65.13	W0.00 B0.00 T66.78	W0.00 B0.00 T67.28
Dump Truck, Asphalt Distributor, Tack Spreader	W33.90 B31.23 T65.13	W0.00 B0.00 T66.78	W0.00 B0.00 T67.28
Euclid-type vehicles (large, off-road equipment)	W34.05 B31.23 T65.28	W0.00 B0.00 T66.93	W0.00 B0.00 T67.43
Helper on Asphalt Distributor	W33.90 B31.23 T65.13	W0.00 B0.00 T66.78	W0.00 B0.00 T67.28
Slurry Seal, Vacuum or Vac-All trucks	W33.90 B31.23 T65.13	W0.00 B0.00 T66.78	W0.00 B0.00 T67.28
Straight 3-axle truck	W33.95 B31.23 T65.18	W0.00 B0.00 T66.83	W0.00 B0.00 T67.33
Tractor Trailer (all types)	W34.05 B31.23 T65.28	W0.00 B0.00 T66.93	W0.00 B0.00 T67.43
Winch Trailer	W34.15 B31.23 T65.38	W0.00 B0.00 T67.03	W0.00 B0.00 T67.53

Expiration Date: 04/30/2016

Craft: Truck Driver

COMMENTS/NOTES

BLENDED RATE:

When a truck driver is performing work on the site and also serving as a material delivery driver, the driver shall be paid a "blended rate" which shall be 80% of the above-listed wage rates, plus the full benefit rate. This rate shall be used when the driver "round robins" for a minimum of 6 hours during the work day.

HAZARDOUS WASTE REMOVAL:

- On hazardous waste removal work on a State designated hazardous waste site where the driver is in direct contact with hazardous materials and when personal protective equipment is required for respiratory, skin, and eye protection, the driver shall receive an additional \$3.00 per hour (with or without protective gear).
- A hazardous waste related certified worker at a designated hazardous waste site who is not working in a zone requiring level A, B or C personal protection shall receive an additional \$1.00 per hour.

TRUCK FOREMAN: \$.75 cents per hour above regular rate. Overtime shall be increased accordingly.

The regular workday shall be 8 hours, starting between 6:00 AM and 8:00 AM.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

SHIFT DIFFERENTIALS:

- Shifts starting at 4:00 PM (2nd Shift): + \$2.50 per hour.
- Shifts starting at 12:00 AM (midnight/3rd Shift): time and one-half the hourly rate.
- Shifts starting at a time other than from 6:00 AM to 8:00 AM, when such hours are mandated by the project owner: + \$2.50 per hour.

OVERTIME:

- Hours in excess of 8 per day, or before or after the regular workday, Monday through Friday, that are not shift work, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays and holidays shall be paid at double the hourly rate.
- Employees may work four 10-hour days at straight time, Monday through Thursday, with Friday used as a make-up day for a lost day. If Friday is not a make-up day, then all hours on Friday shall be paid at time and one-half the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, Presidents' Day, Memorial Day (Decoration Day), July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday. The day after Thanksgiving may be substituted for Veterans' Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Truck Driver-Material Delivery Driver

PREVAILING WAGE RATE

	05/01/12
Driver	W24.15 B10.22 T34.37
New Hires (1st year)	W22.03 B9.07 T31.10

Expiration Date: 05/01/2013

Craft: Truck Driver-Material Delivery Driver

COMMENTS/NOTES

BLENDED RATE:

When a truck driver is performing work on the site and also serving as a material delivery driver, the driver shall be paid a "blended rate". See the "Truck Driver" craft for the blended rates.

The regular workday is 8 hours, starting between 5:00 AM and 8:00 AM.

SHIFT DIFFERENTIAL:

For shifts beginning between 4:00 PM and 10:00 PM, drivers shall receive an additional \$0.50 per hour.

OVERTIME:

Hours in excess of 8 per day, or before or after the regular workday that are not shift work, Monday through Friday, and all hours on Saturdays shall be paid at time and one-half the hourly rate. All hours on Sundays shall be paid at two and one-half times the hourly rate. All hours on holidays shall be paid at double the hourly rate.

RECOGNIZED HOLIDAYS: New Year's Day, President's Day, Memorial Day (Decoration Day), July 4th, Labor Day, Presidential Election Day, Veterans' Day, Thanksgiving Day, Christmas Day. Sunday holidays will be observed the following Monday. The day after Thanksgiving may be substituted for Veterans' Day.

**NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
PREVAILING WAGE RATE DETERMINATION**

County - BERGEN

Craft: Welder

PREVAILING WAGE RATE

Welder

Expiration Date:

Craft: Welder

COMMENTS/NOTES

Welders rate is the same as the craft to which the welding is incidental .

THE PUBLIC WORKS CONTRACTOR REGISTRATION ACT

Please be advised of legislation recently signed into law that will effect public advertisement for bids, solicitation of quotations and the award of certain public contracts, P.L. 1999, c. 238. "THE PUBLIC WORKS CONTRACTOR REGISTRATION ACT" will become effective on April 11, 2000.

Contractors performing covered public work on the effective date must apply for registration within 30 days. Contractors not performing public work on the effective date of the Act must apply for registration before bidding on a public works contract. A copy of the completed and submitted registration application will establish eligibility for award for a period of 30 days.

For purposes of "THE PUBLIC WORKS CONTRACTOR REGISTRATION ACT," "Public Works", is defined as "the construction, reconstruction, demolition, alteration, repair or maintenance of a public building regularly open to and used by the general public or a public institution, and includes any subcontractor or lower tier subcontractor as defined herein, except that for purposes of the Act, no pumping station, treatment plant or other facility associated with utility and environmental construction, reconstruction, demolition, alteration, repair or maintenance shall be regarded as a public building regularly open to and used by the general public or a public institution.

It is important to note that, any work subject to the New Jersey Prevailing Wage Act, (N.J.S.A. 34:11-56.25 et. Seq.), requires compliance with that Act as regards the payment of prevailing wage rates, postings, and completion and submission of certified payrolls, etc.

To avoid potential contract delays and completion extensions, it is suggested public body contracting units and their agents begin to include contractor registration language in advertisements for bids and solicitations for quotations. Evidence of contractor registration should be added to the list of requirements included in future bid specifications and confirmation of registration made on contracts awarded on and after April 11, 2000.

Registration Application Forms and copies of THE PUBLIC WORKS CONTRACTOR REGISTRATION ACT may be obtained by contacting:

Contractor Registration Unit
New Jersey Department of Labor
Division of Wage & Hour Compliance
PO Box 389
Trenton, New Jersey 08625-0389
Telephone: (609) 292-9464
Fax: (609) 633-8591

SECTION 011000

SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specifications format and conventions.
6. Codes and standards.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Work of all Sections in the Specifications. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.
- B. Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:
1. Contract modifications (such as Change Orders) of later date take precedence over those of earlier date;
 2. the Agreement;
 3. Addenda of later date take precedence over those of earlier date;
 4. the Supplementary Conditions;
 5. The General Conditions;
 6. Drawings and Specifications; Drawings govern Specifications for quantity and location. Specifications govern Drawings for quality and performance. In the event of ambiguity or conflicts, the greater quantity and the better quality shall govern.

1.4 PROJECT INFORMATION

- A. Project Identification: The Project consists of interior and exterior improvements to College Commons.
- B. Owner Identification: Ramapo College of New Jersey.

- C. Architect Identification: The Contract Documents were prepared for this Project by ikon.5 architects.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The work includes the following:

1. Selective demolition.
2. Miscellaneous sitework.
3. Architectural work.
4. Structural work.
5. Electrical work.
6. Plumbing work.

1.6 ACCESS TO SITE

- A. General: Access to Project site and hours of work operation shall be coordinated with the Owner.
- B. Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of the Project.
 1. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 2. Driveways, Walkways and Entrances: Keep driveways, parking areas, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 WORK RESTRICTIONS

- A. General: Comply with Owner's requirements.
- B. Nonsmoking Campus: The Ramapo College of New Jersey Campus is a smoke-free environment. Smoking will not be permitted within the building structure nor any place on the Project site.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

1.8 SPECIFICATION FORMAT AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format of the Construction Specifications Institute's (CSI) 2012 edition of the "MasterFormat" numbering system.
 1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 CODES AND STANDARDS

- A. All references to codes, specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the edition indicated in the corresponding construction subcode that governs the work or portion of the work indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 03 through 33 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

- b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES or from a model code organization acceptable to authorities having jurisdiction.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 012600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions" or form acceptable to Owner.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. AIA Document G709/Proposal Request issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time 5 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

- b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: AIA Document G709/Proposal Request or use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 012613

REQUESTS FOR INTERPRETATION (RFI)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Requests for Interpretation.

1.3 DEFINITIONS

- A. Requests for Interpretation (RFI): Contractor initiated written instrument related to the execution of the Work that is addressed to the Architect. The RFI shall be used by the Contractor as the means to ask questions related to the Work; subject to the conditions contained within this Section.

1.4 ACTION SUBMITTALS

- A. Requests for Interpretation: Include a detailed, legible description of an item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Reference to appropriate documents:
 - a. Specification Section number and title and related paragraphs.
 - b. Drawing number and detail references.
 - c. Schedule.
 - d. Other Contract Documents, if any.
 - 9. Field dimensions and conditions, as appropriate.
 - 10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 11. Contractor's signature.

12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

B. RFI Forms: Use form acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

1.5 INFORMATIONAL SUBMITTALS

A. RFI Log: Prepare, maintain, and submit a tabular log of RFI organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

1.6 QUALITY ASSURANCE

A. Authorship: Prior to the commencement of the RFI process, designate a full time "RFI Manager" whose duties shall include the responsibility for enforcing the Request for Interpretation provisions of this Section, to maintain an up-to-date log of all RFI, advise the Architect, in writing, of the status and disposition of all RFI at the progress meetings, and be a member of the Contractor's staff. The RFI Manager shall be experienced in administration and supervision of the type of Work indicated on the Contract Documents.

1. RFI Manager may be the Contractor's Job Superintendent.
2. Each RFI shall originate solely from the RFI Manager. An RFI submitted to the Architect by an entity, or individual, other than the RFI Manager shall be returned to the Contractor.

1.7 ADMINISTRATIVE REQUIREMENTS

A. Processing Time: Allow 5 working days for Architect's response for each RFI. RFI received by Architect after 3:00 p.m. will be considered as received the following business day.

1. Allow additional time if coordination with other work is required. Architect will advise Contractor when a RFI being processed must be delayed for coordination.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

- B. Architect's action on RFI that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Proposal Request according to Section 01 26 00 "Contract Modification Procedures."
 - 1. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- C. Frivolous RFI:
 - 1. RFI shall not be used for the following:
 - a. Request for approval of submittals.
 - b. Request approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Request for adjustment in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Requests for coordination information already indicated in the Contract Documents, or to transfer coordination responsibility from the Contractor to the Owner or Architect.
 - g. Incomplete RFI or inaccurately prepared RFI.
 - 2. The Owner reserves the right to assess the Contractor for the cost (based on time and materials) of a RFI response performed by the Architect, and any of its consultants, which is deemed by the Owner and the Architect as being frivolous or unnecessary.
 - 3. Frivolous RFI shall be removed from the RFI log.

1.8 COORDINATION

- A. Coordination: Coordinate preparation and processing of RFI with performance of construction activities.
 - 1. Submit RFI with such promptness as to cause no delays in the Work. No adjustments of Contract Time or Contract Sum will be granted because of failure to have an RFI submitted with sufficient time to allow for the orderly processing of a response by the Architect.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CONTRACTOR'S ACTION

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, prepare and submit an RFI in the form specified.

- B. Prior to submission of the RFI, coordinate the nature of the inquiry with the requirements of other Sections or trades as related thereto and responses to previous RFI.
- C. Complete each blank on the RFI form.
- D. In preparing each RFI, verify the applicable dimension(s), field conditions, Drawing requirements (small through large scale details), and/or Specification Section requirements pertaining thereto.
- E. Each RFI shall be reviewed, and signed by the RFI Manager prior to transmitting to the Architect.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.

3.2 ARCHITECT'S ACTION

- A. Architect's Action: Architect will review each RFI, determine action required, and respond.
 - 1. Frivolous RFI will be returned without action.
- B. RFI which fail to conform to requirements, (for example, is incomplete or contain numerous errors) shall be returned to the Contractor without a response. No adjustments for Contract Time or Contract Sum shall be granted for an RFI failing to conform to requirements.

END OF SECTION 01 26 13

SECTION 012900
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
- B. Site Visit: Architect's visits to the site at intervals necessary in the judgment of Architect to become generally familiar with the progress and quality of the Work completed and to determine in general if the Work completed is in accordance with the Contract Documents. Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's Construction Schedule.

1. Coordinate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittal Schedule.
 - c. Items required to be indicated as separate activities in Contractor's Construction Schedule.
 2. Submit the Schedule of Values to Architect at earliest possible date, but no later than 7 days before the date scheduled for submittal of initial Application for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange Schedule of Values consistent with format of AIA Document G703.
 3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of 5 percent of the

Contract Sum. Breakdown of subcontract amounts in the Schedule of Values must be true and accurate.

- a. Include separate line items under principal subcontracts for Project closeout activities and requirements in an amount totaling 5 percent of the Contract Sum for all subcontract amounts.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if off-site storage is permitted by Owner.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the Schedule of Values for each allowance, if any. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration, if any.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide description of item(s) being stored.
 - 2. Location of the bonded warehouse(s) where materials or equipment is stored, only if permitted by Owner.
 - 3. Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the stored item(s).
 - 4. Statement certifying that item or any part thereof will not be installed in any construction other than Work under this Contract.
 - 5. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 - 6. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 7. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

- c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit notarized waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors, principal suppliers and fabricators.
 - 2. Schedule of Values.
 - 3. Contractor's Construction Schedule (preliminary if not final).
 - 4. Products List (preliminary if not final).
 - 5. Submittal Schedule (preliminary if not final).
 - 6. List of Contractor's staff assignments.
 - 7. List of Contractor's principal consultants.
 - 8. Copies of building permits.
 - 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 10. Initial progress report.
 - 11. Report of preconstruction conference.
 - 12. Certificates of insurance and insurance policies.
 - 13. Performance and payment bonds, if provided under the Construction Contract.

14. Data needed to acquire Owner's insurance.
 15. Construction Waste Management Plan.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete. Include the following:
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.
 3. Submit executed warranty and maintenance agreements.
 4. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 - a. Transmittal of required Project Record Documents to Owner.
 - b. Evidence of completion of demonstration and training.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.
- 1.6 REVIEW OF APPLICATION FOR PAYMENT
- A. Draft Copy: Submit draft (pencil) copy of the Application for Payment 10 days prior to due date for review by Architect.

- B. Draft Copy Review Meeting: The Owner, Architect and Contractor shall meet prior to payment application due date to review the draft (pencil) copy of the Application for Payment. Questions resulting from this review shall be answered by the Contractor and clarified prior to receipt of the official copy of the Application for Payment.
- C. Upon receipt of the official Application for Payment and other documentation as required by the Architect, including the updated Schedule of Values and the updated Contractor's Construction Schedule, the Architect shall review the documents received to determine if they correspond to the agreements reached during the draft (pencil) copy review meeting. If necessary, the Architect shall revise the Application for Payment to correspond to the agreements reached, execute the Certificate for Payment, and forward the executed copies to the Owner.
- D. The Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor. Issuance of a Certificate of Payment will not be deemed to represent that the Architect has performed audits of the supporting data.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Administrative and supervisory personnel.
 - 4. Project meetings.
- B. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities or as specified in individual Sections.
 - 1. Indicate relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.
 - 3. Refer to mechanical and electrical specifications for specific Coordination Drawing requirements for mechanical and electrical installations.
- B. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A "Subcontractors and Major Material Suppliers List." Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Arrange pipes, ducts, conduits, and other overhead systems in an orderly manner when indicated to remain exposed.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of Contractor's Submittal Schedule.
 3. Preparation of the Schedule of Values.
 4. Installation and removal of temporary facilities and controls.
 5. Delivery and processing of submittals.
 6. Progress meetings.
 7. Preinstallation conferences.
 8. Startup and adjustment of systems.

9. Project closeout activities.

- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

- a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- e. Indicate required installation sequences.
- f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- B. Coordination Drawing Organization:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
 4. Notification: Inform participants 3 days prior to meetings not regularly scheduled.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Convene the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other

concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

- a. Tentative construction schedule.
- b. Project coordination.
- c. Critical work sequencing and long-lead items.
- d. Designation of key personnel and their duties.
- e. Lines of communications.
- f. Requirements in individual Specification Sections for preconstruction responsibilities.
- g. Procedures for processing Requests for Interpretation (RFIs.)
- h. Procedures for processing submittals.
- i. Procedures for processing substitutions.
- j. Procedures for processing field decisions, proposal requests and Change Orders.
- k. Procedures for testing and inspecting.
- l. Procedures for processing Applications for Payment.
- m. Distribution of the Contract Documents.
- n. Preparation of Record Documents.
- o. Use of the premises.
- p. Work restrictions.
- q. Working hours.
- r. Owner's occupancy requirements.
- s. Responsibility for temporary facilities and controls.
- t. Procedures for moisture and mold control.
- u. Procedures for disruptions and shutdowns.
- v. Construction waste management and recycling.
- w. Office, work, and storage areas.
- x. Parking availability.
- y. Equipment deliveries and priorities.
- z. First aid.
- aa. Security.
- bb. Progress cleaning.

- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.

- e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.

- h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures for closeout documents.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Pending changes
 - 4) Status of submittals.
 - 5) Status of RFIs.
 - 6) Status of proposal requests.
 - 7) Status of Change Orders.
 - 8) Deliveries.
 - 9) Off-site fabrication.
 - 10) Access.
 - 11) Site utilization.
 - 12) Temporary facilities and controls.
 - 13) Work hours.
 - 14) Hazards and risks.
 - 15) Quality and work standards.
 - 16) Progress cleaning.
 - 17) Documentation of information for payment requests.
 - 18) Other business relating to the Work.

4. Reporting: Distribute minutes of the meeting to each party present and to parties requiring information. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: In addition to representatives of Owner and Architect, each subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each subcontract or major work element is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each subcontractor or supplier present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Pending changes
 - 4) Status of submittals.
 - 5) Status of RFIs.
 - 6) Status of proposal requests.
 - 7) Status of Change Orders.
 - 8) Deliveries.
 - 9) Off-site fabrication.
 - 10) Access.
 - 11) Site utilization.
 - 12) Temporary facilities and controls.
 - 13) Work hours.
 - 14) Hazards and risks.

- 15) Quality and work standards.
 - 16) Progress cleaning.
 - 17) Documentation of information for payment requests.
 - 18) Other business relating to the Work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Daily construction reports.
 - 3. Site condition reports.
 - 4. Special reports.
- B. Related Sections:
 - 1. Section 01 31 00 "Project Management and Coordination" for submitting and distributing Project meeting minutes.
 - 2. Section 01 32 33 "Photographic Documentation" for submitting construction progress photographs.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
 - 3. Two paper copies.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. CPM Reports: Concurrent with CPM schedule, submit each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of all activities sorted in ascending order of total float.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: Engage an experienced specialist or consultant to provide CPM scheduling, planning, evaluation and reporting, with capability of producing CPM reports and diagrams within 24 hours of request.
1. In-House Option: Contractor may employ skilled personnel with experience in CPM scheduling and reporting techniques.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work or a Notice to Proceed to date of Substantial Completion and final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 2. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Include selection process activities for finishes and products specified to be selected during the sample review process. Coordinate submittal review times in Contractor's Construction Schedule with Submittal Schedule.
 3. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Products Ordered in Advance: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
 3. Owner-Furnished Products: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.

- g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
 - 6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Building envelope or permanent enclosure.
 - d. Completion of HVAC installation.
 - e. Completion of plumbing installation.
 - f. Completion of fire protection installation.
 - g. Completion of electrical installation.
 - h. Completion of information technology installations.
 - i. Completion of communications installations.
 - j. Completion of security installations.
 - k. Substantial Completion.
 - D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, commencement of Work or a Notice to Proceed, Substantial Completion, and final completion.
 - E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Interpretation (RFIs).
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
 - F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules. Coordinate with Owner and Architect regarding which project management software will be used on the Project.
 - 1. Compatibility: All software shall comply with Owner's master scheduling software requirements.
- 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. General: Prepare network diagrams using AON (activity-on-node) format.

- B. Startup Network Diagram: Submit diagram within 7 days of date established for commencement of the Work or a Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work or a Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Testing.
 - i. Punch list and final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Construction Schedule: Not later than 15 days after date established for commencement of the Work or a Notice to Proceed, prepare and submit initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal or main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. Approximate count of personnel at Project site.
 3. Equipment at Project site.
 4. Material deliveries.
 5. High and low temperatures and general weather conditions, including presence of rain or snow.
 6. Accidents.
 7. Meetings and significant decisions.
 8. Unusual events (see special reports).
 9. Stoppages, delays, shortages, and losses.

10. Meter readings and similar recordings.
11. Tests and inspections, including name(s) of testing and inspection agency(ies).
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Interpretation (RFI). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one (1) day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate actual completion percentage for each activity.
 4. Notify Owner and Architect of all anticipated significant revisions to the Construction Schedule prior to issuance of updated schedule.
- B. Distribution: Distribute copies of approved Construction Schedule to Owner, Architect, subcontractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Furnish Owner and Architect with an updated electronic version of the Construction Schedule each month.
2. Post copies in Project meeting rooms and temporary field offices.
3. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 013233

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
- B. Related Sections:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 - 2. Section 024119 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within 3 days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.

- f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Construction Photographs: Submit 2 prints of each photographic view within 7 days of taking photographs.
 - 1. Format: 8-by-10-inch (203-by-254-mm) smooth-surface matte prints on single-weight, commercial-grade photographic paper; mounted on linen or card stock to allow a 1-inch- (25-mm-) wide margin and enclosed back to back in clear plastic sleeves that are punched for standard three-ring binder.
 - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than 5 years.

1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.

- B. Provide digital photographs and hard-copy prints as construction photographs.
- C. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- D. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- E. Preconstruction Photographs: Before commencement of work, take photographs of Project site including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Take representative photographs to show existing conditions before commencement of Work.
- F. Periodic Construction Photographs: Take 12 representative photographs to show progress monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- G. Final Completion Construction Photographs: Take 12 representative color photographs after date of Substantial Completion for submission as project record documents. Architect will select desired vantage points for photographer.
 - 1. Do not include date stamp.

END OF SECTION 01 32 33

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
 - 3. Section 014000 "Quality Requirements" for submitting test and inspection reports and for erecting mockups.
 - 4. Section 017700 "Closeout Procedures" for submitting warranties, operation and maintenance manuals, and closeout submittals.
 - 5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 7. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet

protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Contractor's Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by Contractor's Construction Schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate Submittal Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Initial Submittal: Submit within 15 days of commencement of Work or a Notice to Proceed. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
 - a. Submit revised Submittal Schedule to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action or informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - a. Scheduled dates for purchasing, if necessary for critical path scheduling.
 - b. Scheduled dates for installation, if necessary for critical path scheduling.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all action and information submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved Submittal Schedule.
 - a. Exception: Where samples for initial selection and samples for verification are both required, submit samples for verification after initial selection has been returned by Architect.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. Architect will document on submittal the date of receipt. Submittals received by Architect after 3:00 p.m. will be considered as received the following working day. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 days for initial review of each submittal, unless otherwise agreed upon in the final approved Submittal Schedule. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.
 2. Sequential Review: Sequential review is a submittal that requires review by more than one design discipline. Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, Submittal Schedule shall reflect sequential review and allow 15 days for initial review of each submittal, unless otherwise agreed upon in the final approved Submittal Schedule.
 3. Concurrent Consultant Review: Transmit submittals directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Allow 15 days for initial review of each submittal, unless otherwise agreed upon in the final approved Submittal Schedule. Submittal will be returned to Architect before being returned to Contractor.
 4. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 5. Resubmittal Review: Allow 10 days for review of each resubmittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 4 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:

- a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier for submittal number, including revision identifier. The numbering system shall be retained throughout all revisions.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a three-digit sequential number (e.g., 061000.001). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.001.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
6. Transmittal Form: Use Submittal Transmittal, CSI Form 12.1A included in Project Manual as Form 006001.
- E. Electronic Submittals: Identify and incorporate information specified for paper submittals in each electronic submittal file as follows:
- 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with unique identifier for submittal number, including revision identifier. The numbering system shall be retained throughout all revisions.
 - a. File name shall use Project identifier and unique identifier for submittal number, including revision identifier. The numbering system shall be retained throughout all revisions.
 - b. Project identifier: Ramapo.
 - c. Submittal number: Submittal number shall use Specification Section number followed by a decimal point and then a three-digit sequential number (e.g., 061000.001). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.001.A).

- d. Typical File Name Format: Ramapo.061000.001.A
- 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
- 4. Scanned Copies: Legible scanned PDF files of paper originals are acceptable. Scanned submittals that are not legible will be rejected.
- 5. Sheet Orientation: Orient PDF sheets to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.
- 6. File Security: Do not set any permissions on the file. Protected documents will not be accepted.
- 7. Transmittal Form for Electronic Submittals: Use PDF of completed Submittal Transmittal, CSI Form 12.1A included in Project Manual as Form 006001.
- 8. Metadata: Include the following information in the electronic submittal file metadata:
 - a. Title: Project title.
 - b. Author: Contractor's name.
 - c. Subject: Submittal type (Product Data, Shop Drawing, Report, etc.).
 - d. Keywords: Number and title of appropriate Specification Section; manufacturer name; product name/model number.
- 9. File Size: Limit file size of each submittal as follows. Break larger PDF files into multiple packages where necessary to meet delivery restrictions. Identify split packages as "1 of #" and "2 of #" in the subject line.
 - a. Email Delivery: 5 Megabytes.
 - b. FTP Delivery: 100 Megabytes.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp "APPROVED" or "APPROVED AS NOTED."
 - 4. Costs of compensation for Architect's additional services and expenses made necessary for review of submittals exceeding the limits set forth below shall be at the Contractor's expense.
 - a. Reviews of Each Submittal: Two, including initial review.

- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp "APPROVED" or "APPROVED AS NOTED."
- K. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by Architect and returned to Contractor with approval notation from Architect's action stamp marked "APPROVED" or "APPROVED AS NOTED."

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files. Do not post zipped files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit 3 paper copies of each submittal, unless otherwise indicated. Architect will return 2 copies. Mark up and retain one returned copy as a Project Record Document.
 - 3. Informational Submittals: Submit 2 paper copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
 - 5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
 - 6. Systems Submittals: Identify submittals for systems such as fire alarms and fire protection systems, on the transmittal and act upon the system singularly as a combined submittal. If resubmission is required, resubmit entire system submittal,

2.2 ACTION SUBMITTALS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's written recommendations.
 - c. Manufacturer's product specifications.
 - d. Standard color charts.
 - e. Mill reports.
 - f. Standard product operating and maintenance manuals.
 - g. Statement of compliance with specified referenced standards.
 - h. Compliance with recognized trade association standards.
 - i. Compliance with recognized testing agency standards.
 - j. Testing by recognized testing agency.
 - k. Application of testing agency labels and seals.
 - l. Notation of coordination requirements.
 - m. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
- B. Shop Drawings: Prepare and submit Project-specific information, drawn accurately to scale. Do not base Shop Drawings on standard printed data. Do not reproduce, digitally or otherwise, the Contract Documents and submit as Shop Drawings. Do not use, copy or reproduce title blocks, dimensions, notes, keynotes, symbols schedules or details from Contract Drawings, digital or otherwise. Use of the Contract Drawings shall be limited to reproduction, digitally or otherwise, of the exterior wall layout, interior partition layout, grid lines, doors, and windows.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions and layout information.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.

- e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Compliance with specified standards.
 - j. Notation of coordination requirements.
 - k. Notation of dimensions established by field measurement.
 - l. Relationship and attachment to adjoining construction clearly indicated.
 - m. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format: PDF electronic file or opaque paper copies.
- C. Samples: Submit physical Samples of materials or products for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 3. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 4. For electronic submittals, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 1 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
 - b. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples:
 - 1) Submit 3 sets of Samples.
 - 2) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 3) Submit at least 3 sets of paired units that show approximate limits of variations if variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample.
 - b. Architect will retain 1 Sample set(s); remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
8. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.

2.3 INFORMATIONAL SUBMITTALS

- A. Product Schedule or List: Prepare and submit a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit Product Schedule in the following format: PDF electronic file or paper copies.

- B. Subcontract List: Prepare and submit a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Submit on the form "Subcontractors and Major Material Suppliers List," included in Project Manual as Document 00 60 05.
 - 1. Submit Subcontract List in the following format: PDF electronic file or paper copies.
- C. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- D. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- E. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- F. Construction Photographs: Comply with requirements in Section 01 32 33 "Photographic Documentation."
- G. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- H. Daily Construction Reports: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- J. Operation and Maintenance Data: Submit written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- K. Qualification Data: Prepare and submit written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare and submit written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. Preconstruction Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- U. Compatibility Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- V. Field Test Reports: Prepare and submit written reports, written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- W. Manufacturer's Field Reports: Prepare and submit written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- X. Manufacturer's Instructions: Submit written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- Y. Insurance Certificates and Bonds: Prepare and submit written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- Z. Material Maintenance Submittals: Comply with requirements specified in individual Sections for quantity and disposition of delivery of extra stock.
- AA. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- 2.4 DELEGATED-DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit 3 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, coordinated, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that have not been properly transmitted, reviewed by Contractor, or do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it to Contractor. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate one of the following actions:
 - 1. "APPROVED": No further review of Submittal required.
 - 2. "APPROVED AS NOTED". Resubmittal not required unless Contractor cannot comply with corrections noted. Incorporate corrections in Work. If Contractor cannot comply with corrections as noted, revise to respond to notations and resubmit.
 - 3. "REVISE AND RESUBMIT": Revise as noted and resubmit for further review.
 - 4. "RESUBMIT PROPERLY": Submittal not reviewed for reasons noted.
 - 5. "NOT REVIEWED": Submittal not required by Contract Documents. Remove from submittal log.
 - 6. "RECEIVED FOR CLIENT'S RECORD ONLY": Submittal not reviewed.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents will not be reviewed and may be discarded or returned marked "NOT REVIEWED."

- G. Substitution items received as product data, shop drawing, or sample submittals required by individual Sections will be returned to Contractor without review. Comply with requirements in Section 01 25 00 "Substitution Procedures" for submission of substitution request.

END OF SECTION 01 33 00

SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Section 01 78 39 "Project Record Documents" for assembling miscellaneous record submittals.
 - 2. Divisions 03 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

- C. Mockups: Full-size physical assemblies that are constructed on-site, unless otherwise indicated. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
 3. Benchmark Samples: A type of mockup used to illustrate the application and aesthetic effect of finishes and coatings.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity independent of the Owner's and Contractor's operations, engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having a minimum 5 years of experience; having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- K. Professional Engineer: Engineer currently licensed to practice in the State of New Jersey.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.

6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- G. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- H. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

- I. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of commencement of Work or a Notice to Proceed, and not less than 5 days prior to preconstruction conference. Submit in format acceptable to Owner. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a 5 year record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a 5 year record of successful in-service performance.
- E. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a 5 year record of successful in-service performance, as well as sufficient production capacity to produce required units.
- F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- G. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies and mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Fabricate, construct and install test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Fabricate, construct and install test assemblies and mockups using products and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- H. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- I. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists. Requirement for specialists shall not supersede building codes and similar regulations governing the Work.
 - 2. Requirement for specialists shall not interfere with local trade-union jurisdictional settlements and similar conventions.
- J. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow 7 days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed, unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to design indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 2. Demolish and remove mockups when directed, unless otherwise indicated.
- M. Room Mockups: Construct room mockups according to design indicated on Drawings. Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work.
1. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 2. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - a. Construction Control: Perform all construction contractor services required by authorities having jurisdiction.
 - b. If Owner designates Contractor as the responsible person in charge of work, perform additional responsibilities and reporting required by authorities having jurisdiction.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 7. Provide quality assurance and control services required due to changes in the Work proposed by or made by the Contractor.
 8. Provide quality control services for Work done contrary to the Contract Documents, without prior notice or without proper supervision.
 9. Overtime expenses and schedule delays accruing as a result of executing quality control services shall be the Contractor's responsibility and shall not be charged to the Owner.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
1. Architect retains the right to require the use of a different testing agency for retesting and reinspecting.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
 7. Attend Project progress meetings as requested.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as

requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 1. Delivery of samples to testing agencies or arranging for pick-up of test samples after normal business hours.
 2. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 3. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit schedule concurrently with Contractor's Construction Schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 014200

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "As Required": As required by regulatory bodies, by referenced standards, by existing conditions, by generally accepted construction practice or by the Contract Documents. In the event of ambiguity or conflicts, the most stringent requirements shall apply.
- D. "By Others" refers to work that is not a part of the Contract.
- E. "Day": Unless stated otherwise, "day" means a calendar day.
- F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- I. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- J. "N.I.C.": "Not in Contract" means the work or the item indicated is not a part of the Contract and will be provided by the Owner.
- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

- L. "Provide": Furnish and install, complete and ready for the intended use.
- M. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with editions of standards referenced in the corresponding construction subcode for the work or portion of the work indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.
 - 1. AA; Aluminum Association (The); www.aluminum.org.
 - 2. AAADM; American Association of Automatic Door Manufacturers; www.aaadm.com.
 - 3. AABC - Associated Air Balance Council; www.aabc.com.
 - 4. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 5. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 6. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 7. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 8. ABAA; Air Barrier Association of America; www.airbarrier.org.
 - 9. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 10. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 11. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
 - 12. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 13. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 14. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 15. AGA - American Gas Association; www.aga.org.
 - 16. AGC; Associated General Contractors of America (The); www.agc.org.
 - 17. AHA; American Hardboard Association; <http://domensino.com/AHA>.

18. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
19. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
20. AI - Asphalt Institute; www.asphaltinstitute.org.
21. AIA - American Institute of Architects (The); www.aia.org.
22. AISC - American Institute of Steel Construction; www.aisc.org.
23. AISI - American Iron and Steel Institute; www.steel.org.
24. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
25. ALSC; American Lumber Standard Committee, Incorporated; www.alsc.org.
26. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
27. ANLA; American Nursery & Landscape Association; www.anla.org.
28. ANSI - American National Standards Institute; www.ansi.org.
29. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
30. APA - APA - The Engineered Wood Association; www.apawood.org.
31. APA - Architectural Precast Association; www.archprecast.org.
32. API - American Petroleum Institute; www.api.org.
33. APWA; American Public Works Association; www.apwa.net.
34. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
35. ARI - American Refrigeration Institute; (See AHRI).
36. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
37. ASA; Acoustical Society of America; www.acousticalsociety.org.
38. ASC; Adhesive and Sealant Council (The); www.ascouncil.org.
39. ASCA; Architectural Spray Coaters Association.
40. ASCE - American Society of Civil Engineers; www.asce.org.
41. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
42. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
43. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
44. ASPE; American Society of Plumbing Engineers; www.aspe.org.
45. ASSE - American Society of Safety Engineers (The); www.asse.org.
46. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
47. ASTM - ASTM International; www.astm.org.
48. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
49. AWCI; Association of the Wall and Ceiling Industry; www.awci.org.
50. AWEA - American Wind Energy Association; www.awea.org.
51. AWI - Architectural Woodwork Institute; www.awinet.org.
52. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
53. AWWA - American Water Works Association; www.awwa.com.
54. AWS - American Welding Society; www.aws.org.
55. AWWA - American Water Works Association; www.awwa.org.
56. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
57. BIA - Brick Industry Association (The); www.gobrick.com.
58. BICSI - BICSI, Inc.; www.bicsi.org.
59. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
60. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
61. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.

62. CCC; Carpet Cushion Council; www.carpetcushion.org.
63. CCFSS; Center for Cold-formed Steel Structures; www.ccfsonline.org.
64. CDA - Copper Development Association; www.copper.org.
65. CEA - Canadian Electricity Association; www.electricity.ca.
66. CEA - Consumer Electronics Association; www.ce.org.
67. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
68. CFI; International Certified Floorcovering Installers Association; www.cfi-installers.org.
69. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
70. CGA - Compressed Gas Association; www.cganet.com.
71. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
72. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
73. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
74. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
75. CPA - Composite Panel Association; www.pbmdf.com.
76. CPPA; Corrugated Polyethylene Pipe Association; www.plasticpipe.org/drainage/index.html.
77. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
78. CRRC - Cool Roof Rating Council; www.coolroofs.org.
79. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
80. CSA - Canadian Standards Association; www.csa.ca.
81. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
82. CSI - Construction Specifications Institute (The); www.csinet.org.
83. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
84. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
85. CWC - Composite Wood Council; (See CPA).
86. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
87. DHI - Door and Hardware Institute; www.dhi.org.
88. ECA - Electronic Components Association; (See ECIA).
89. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
90. ECIA - Electronic Components Industry Association; www.eciaonline.org.
91. EIA - Electronic Industries Alliance; (See TIA).
92. EIMA - EIFS Industry Members Association; www.eima.com.
93. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
94. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
95. ESTA - Entertainment Services and Technology Association; (See PLASA).
96. EVO - Efficiency Valuation Organization; www.evo-world.org.
97. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
98. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
99. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
100. FM Approvals - FM Approvals LLC; www.fmglobal.com.
101. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
102. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
103. FSA - Fluid Sealing Association; www.fluidsealing.com.
104. FSC - Forest Stewardship Council U.S.; www.fscus.org.
105. GA - Gypsum Association; www.gypsum.org.

106. GANA - Glass Association of North America; www.glasswebsite.com.
107. GBCI; Green Building Certification Institute; www.gbci.org.
108. GS - Green Seal; www.greenseal.org.
109. GSI; Geosynthetic Institute; www.geosynthetic-institute.org.
110. GTA; Glass Tempering Division of Glass Association of North America; (see GANA).
111. HI - Hydraulic Institute; www.pumps.org.
112. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
113. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
114. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
115. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
116. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
117. IAS - International Accreditation Service; www.iasonline.org.
118. IAS - International Approval Services; (See CSA).
119. ICBO - International Conference of Building Officials; (See ICC).
120. ICC - International Code Council; www.iccsafe.org.
121. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
122. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
123. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
124. IEC - International Electrotechnical Commission; www.iec.ch.
125. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
126. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
127. IESNA - Illuminating Engineering Society of North America; (See IES).
128. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
129. IGCC; Insulating Glass Certification Council; www.igcc.org.
130. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
131. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
132. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
133. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
134. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
135. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
136. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
137. ISO - International Organization for Standardization; www.iso.org.
138. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
139. ITU - International Telecommunication Union; www.itu.int/home.
140. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
141. LMA - Laminating Materials Association; (See CPA).
142. LPI - Lightning Protection Institute; www.lightning.org.
143. MBMA - Metal Building Manufacturers Association; www.mbma.com.
144. MCA - Metal Construction Association; www.metalconstruction.org.
145. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
146. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
147. MHIA - Material Handling Industry of America; www.mhia.org.
148. MIA - Marble Institute of America; www.marble-institute.com.

149. MIA; Masonry Institute of America; www.masonryinstitute.org.
150. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
151. MPI - Master Painters Institute; www.paintinfo.com.
152. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
153. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
154. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
155. NADCA - National Air Duct Cleaners Association; www.nadca.com.
156. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
157. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
158. NBI - New Buildings Institute; www.newbuildings.org.
159. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
160. NCMA - National Concrete Masonry Association; www.ncma.org.
161. NCPI; National Clay Pipe Institute; www.ncpi.org.
162. NCTA; National Cable & Telecommunications Association; www.ncta.com.
163. NEBB - National Environmental Balancing Bureau; www.nebb.org.
164. NECA - National Electrical Contractors Association; www.necanet.org.
165. NelMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
166. NEMA - National Electrical Manufacturers Association; www.nema.org.
167. NETA - InterNational Electrical Testing Association; www.netaworld.org.
168. NFHS - National Federation of State High School Associations; www.nfhs.org.
169. NFPA - National Fire Protection Association; www.nfpa.org.
170. NFPA - NFPA International; (See NFPA).
171. NFRC - National Fenestration Rating Council; www.nfrc.org.
172. NGA; National Glass Association; www.glass.org.
173. NHLA - National Hardwood Lumber Association; www.nhla.com.
174. NLGA - National Lumber Grades Authority; www.nlga.org.
175. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
176. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
177. NRCA - National Roofing Contractors Association; www.nrca.net.
178. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
179. NSF - NSF International; www.nsf.org.
180. NSPE - National Society of Professional Engineers; www.nspe.org.
181. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
182. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
183. NWFA - National Wood Flooring Association; www.nwfa.org.
184. PCA; Portland Cement Association; www.cement.org.
185. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
186. PDCA; Painting and Decorating Contractors of America; www.pdca.com.
187. PDI - Plumbing & Drainage Institute; www.pdionline.org.
188. PGI; PVC Geomembrane Institute; <http://pgi-tp.ce.uiuc.edu>.
189. PLANET; Professional Landscape Network; www.landcarenetwork.org.
190. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
191. PTI; Post-Tensioning Institute; www.post-tensioning.org.
192. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
193. RFCI - Resilient Floor Covering Institute; www.rfci.com.
194. RIS - Redwood Inspection Service; www.redwoodinspection.com.

195. RMA; Rubber Manufacturers Association; www.rma.org.
196. SAE - SAE International; www.sae.org.
197. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
198. SDI - Steel Deck Institute; www.sdi.org.
199. SDI - Steel Door Institute; www.steeldoor.org.
200. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
201. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
202. SGCC; Safety Glazing Certification Council; www.sgcc.org.
203. SIA - Security Industry Association; www.siaonline.org.
204. SJI - Steel Joist Institute; www.steeljoist.org.
205. SMA - Screen Manufacturers Association; www.smainfo.org.
206. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
207. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
208. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
209. SPIB - Southern Pine Inspection Bureau; www.spib.org.
210. SPRI - Single Ply Roofing Industry; www.spri.org.
211. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
212. SSINA - Specialty Steel Industry of North America; www.ssina.com.
213. SSMA; Steel Stud Manufacturers Association; www.ssma.com.
214. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
215. STI - Steel Tank Institute; www.steeltank.com.
216. SWI - Steel Window Institute; www.steelwindows.com.
217. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
218. SWRI; Sealant, Waterproofing, and Restoration Institute; www.swrionline.org.
219. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
220. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
221. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
222. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
223. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
224. TMS - The Masonry Society; www.masonrysociety.org.
225. TPI - Truss Plate Institute; www.tpinst.org.
226. TPI - Turfgrass Producers International; www.turfgrasssod.org.
227. TRI - Tile Roofing Institute; www.tilerroofing.org.
228. UBC; Uniform Building Code; (See ICC).
229. UFAC; Upholstered Furniture Action Council; www.ufac.org.
230. UL - Underwriters Laboratories Inc.; www.ul.com.
231. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
232. USAV - USA Volleyball; www.usavolleyball.org.
233. USGBC - U.S. Green Building Council; www.usgbc.org.
234. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
235. WASTEC - Waste Equipment Technology Association; www.wastec.org.
236. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
237. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
238. WDMA - Window & Door Manufacturers Association; www.wdma.com.
239. WI - Woodwork Institute; www.wicnet.org.
240. WMPMA; Wood Moulding & Millwork Producers Association; (See MMPA).

241. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
242. WPA; Western Wood Products Association; www.wwpa.org.
243. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names and web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. ADAAG; Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; www.access-board.gov.
 2. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 3. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 4. DSCC - Defense Supply Center Columbus; (See FS).
 5. FED-STD - Federal Standard; (See FS).
 6. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 7. MILSPEC - Military Specification and Standards; (See DOD).
 8. USAB - United States Access Board; www.access-board.gov.
 9. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

NJUCC	New Jersey Uniform Construction Code
DCA	Department of Community Affairs
	Division of Codes and Standards
	www.nj.gov/dca/codes/

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections:
 - 1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Division 1 Section "Construction Waste Management and Disposal."
 - 3. Divisions 3 through 33 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum, unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Occupants of Project.
 - 2. Architect.
 - 3. Testing agencies.
 - 4. Personnel of authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all parties and entities engaged in construction operations at the Project Site.
 - 1. Existing sewer system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all parties and entities engaged in construction operations at the Project Site.

1. Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all parties and entities engaged in construction operations at the Project Site.
 1. Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste handling procedures.
 5. Other dust-control measures.
- F. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Existing Utilities and Facilities: The Contractor is responsible for operation, maintenance, and protection of each existing, temporary, and permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
 - 1. At earliest feasible times, change over from use of temporary services to use of permanent services.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials suitable for use intended. Undamaged, previously used materials in serviceable condition may be used where appropriate.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized-steel, chain-link fabric fencing; minimum 8 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete bases for supporting posts.
- C. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- F. Paint: Comply with requirements in Division 09 Section "Painting."

- G. Polyethylene Sheet: Reinforced, fire-resistive sheet, **10-mil** minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- H. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- I. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum **36 by 60 inches**.
- J. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. General: Provide temporary facilities and equipment suitable for use intended.
- B. Field Offices: Prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- C. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect and its Consultants, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and **4-foot** square tack board and marker board.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of **68 to 72 degrees F**.
 - 6. Lighting fixtures capable of maintaining average illumination of **20 footcandles** at desk height.
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Comply with NFPA 241.
 - 2. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated. Provide class, extinguishing agent, and size in accordance with NFPA 10 requirements for locations and classes of fire exposures.
- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

- C. Drinking Water Fixtures: Containerized, tap-dispenser, bottled-water drinking water units, including paper cup supply.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
- A. HVAC Equipment: Existing or permanent HVAC system may be used subject to coordination and approval by the Owner. Permanent systems that are used for temporary facilities including ductwork shall be cleaned at Project Closeout; replace all filters.
 - 1. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - a. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. For temporary use of existing or permanent HVAC System during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Remove effluent lawfully.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 2. Maintain sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
 3. Drinking Water Facilities: Provide bottled-water, drinking water units.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- I. Telephone Service: Access to Owner's telephone lines and network shall not be permitted. Provide temporary telephone service and wireless cellular telephone service throughout construction period in common-use facilities for use by all personnel engaged in construction activities.
1. Provide telephone service for each field office and first-aid station.
 2. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each modem or router connection serving facsimile machines and computer equipment in each field office.

3. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Consulting Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
4. Provide superintendent with cellular telephone or portable two-way radio for use in making and receiving calls when away from field office.
 - a. Provide an answering machine, voice-mail service, or messaging service on superintendent's telephone.
- J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
 2. Memory: 4 gigabyte.
 3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 4. Display: 22-inch LCD monitor with 256-Mb dedicated video RAM.
 5. Full-size keyboard and mouse.
 6. Network Connectivity: 10/100BaseT Ethernet.
 7. Operating System: Microsoft Windows XP Professional or Microsoft Windows Vista Business.
 8. Productivity Software:
 - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader 7.0 or higher.
 - c. WinZip 7.0 or higher.
 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 12. Backup: External hard drive, minimum 40 gigabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within **30 feet** of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Use only designated areas of Owner's existing parking areas for construction personnel.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, grounds, landscaped areas, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

E. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Unauthorized signs are not permitted.

1. Project identification sign: Engage commercial signage company to produce project identification signage that is durable and suitable for exterior (weather) exposure. Include the following information:
 - a. Project identification.
 - b. Owner identification.
 - c. Architect's identification.
 - d. Consulting engineers' identifications.
 - e. Contractor's identification.
2. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with requirements specified in Section 017300 "Execution" for progress cleaning requirements. Comply with additional requirements specified in Section 017419 "Construction Waste Management and Disposal."

- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Avoid using tools and equipment that produce harmful noise.
 - 2. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings, requirements of 2003 EPA Construction General Permit, or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Prior to commencement of construction operations, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering Project site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day. Furnish one set of keys to Owner.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects on products.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side of framing.
 2. Insulate partitions to control noise transmission to occupied areas.
 3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 4. Protect air-handling equipment.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
 2. Provide fire extinguishers in visible and accessible locations with identification signage.
 - a. Type: Class ABC multi-purpose, dry-chemical.
 - b. Locate fire extinguishers in accordance with NFPA 10 and where convenient and effective for their intended purpose.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Store combustible materials in containers in fire-safe locations.
5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
6. Develop and supervise an overall fire-prevention and fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
7. If necessary, provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 016000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following administrative and procedural requirements for the following:
 - 1. Product selection.
 - 2. Product delivery, storage, and handling.
 - 3. Product warranties.
 - 4. Comparable products.
- B. Related Sections:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 2. Section 01 77 00 "Closeout Procedures" for submitting warranties for contract closeout.
 - 3. Divisions 03 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage and liquids from freezing.
10. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 3. Refer to Divisions 03 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Components, materials, or parts required to be supplied in quantity within a Section shall be of the same manufacture, shall be interchangeable, and shall be the same with regard to function, texture, pattern, and color.
- B. Except for building equipment in service areas, no manufacturers' labels or name plates shall be visible on any component, unless required by local authorities having jurisdiction.

2.2 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: Unless custom products or nonstandard options are specified, provide products of both quality and type that have been used successfully in similar situations on equal quality projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Procedures for product selection include the following:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products, Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - 4. Manufacturers, Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - 5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of

- manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
6. Visual Matching Specification: Where Specifications require matching an established Sample, provide a product and manufacturer that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
 7. Visual Selection Specification:
 - a. Standard Range: Where Specifications include the phrase "as selected by Architect from manufacturer's standard range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.3 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 017300

EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Repair of the Work
- B. Related Sections:
 - 1. Divisions 3 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 2. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 21 through 28 for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior wall elements.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. New Patching Materials: Comply with requirements specified in Division 3 through 33 Sections of these Specifications.
- C. In-Place or Existing Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground utilities, site improvements, and other construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, site improvements, mechanical and electrical systems, existing construction and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for interpretation to Architect according to Section 01 26 13 "Request for Interpretation." Include a detailed description of problem encountered, together with recommendations for necessary modifications that may be required.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing benchmarks, control and reference points. If discrepancies are discovered, notify Architect promptly.
- B. General: Lay out the Work using accepted practices.
1. Establish benchmarks and control points to set lines and levels as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
- C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, floor levels, and architectural elements including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Make the log available for reference by Architect.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearances indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- K. Protect adjacent property and adjoining work, including sealant bond surfaces, from spillage or blow-over of coatings, paints, sprayed fire-resistive material, and other spray-applied products. Cover adjoining and nearby surfaces, including live plants and grass, if there is possibility of spray-applied products being deposited on surfaces.

3.5 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
- D. Temporary Support: Provide temporary support of work to be cut.
- E. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- F. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching operations with Owner.
- G. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
 - 1. All temporary bypass utilities must be reviewed and approved, in writing, by Owner prior to placing in service.
- H. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Avoid cutting steel reinforcement.

- a. Locate steel reinforcement using Ground Penetrating Radar or Ferroskan prior to cutting or drilling reinforced concrete and masonry. If existing steel reinforcement is in proposed cut or hole location, contact Architect before proceeding with the Work.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- I. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Ceramic Tile: Provide ceramic tile and grout to match existing. Remove and replace tile damaged as a result of Work of this Contract. Comply with TCNA's "Handbook for Ceramic Tile Installation" for installation method to match existing. Lay tile in grid pattern to match existing. Make joints between existing and new tile same width so patches are not apparent in finished work.
 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- J. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces or personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces and personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces and personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 40 00 "Quality Requirements" and additional requirements specified in Division 3 thru Division 33 Specification Sections.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 REPAIR OF THE WORK

- A. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
1. Where damaged or worn items cannot be repaired or restored, provide replacements.
 2. Repair components that do not operate properly.
 3. Remove and replace operating components that cannot be repaired.
 4. Restore damaged construction and permanent facilities used during construction to specified condition.
 5. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 6. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 7. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 8. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 73 00

SECTION 017419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for waste reduction, including salvaging, recycling, and disposing of nonhazardous waste.
- B. Related Sections:
 - 1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Hazardous Materials: Construction and demolition debris that are regulated for disposal by local, city, county, state, or Federal authorities.
- E. Reclamation Materials: Construction and demolition debris that meets the requirements of a product manufacturer's reclamation program where the debris is removed and prepared for shipping to a manufacturer's facility for reuse in producing new products.
- F. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- G. Recyclable Materials: Construction and demolition debris that can be recovered and processed into new products or materials. Recyclable materials include, but are not limited to, the following:

1. Metals: Ferrous (iron, steel, stainless steel, galvanized steel) and non-ferrous (copper, brass, bronze, aluminum) types and containers made from metals such as pails, buckets and beverage cans. Paint cans shall be cleaned to qualify.
2. Concrete.
3. Brick.
4. Gypsum wallboard.
5. Paper products such as generated from field office activities and clean corrugated packaging cardboard.
6. Wood products, including untreated dimensional lumber, plywood, oriented strand board, hardboard, particleboard and crates and pallets made from wood products.
7. Carpet and padding.
8. Plastics and containers made from plastics such as pails, buckets, and beverage bottles.
9. Glass: Glass beverage containers, window and mirror glass.
10. Asphaltic concrete paving.
11. Clean and uncontaminated, excavated soils not intended for other on-site use.
12. Stumps and trees removed as a part of land clearing operations.

- H. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- I. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

- A. Achieve end-of-Project rates for diverting from landfill 75 percent by weight of total non-hazardous solid waste generated by the Work. Use all reasonable and legal means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling, reclamation, and salvage of materials.
- B. Practice efficient waste management in the use of materials in the course of the Work. Reduce waste by minimizing factors that contribute to waste and achieve the most efficient use of resources and materials; uses water efficiently; avoids practices such as over-packaging, improper storage, ordering errors, poor planning, breakage, mishandling and contamination

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work or a Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Submit reports concurrent with each Application for Payment.

- B. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct preconstruction conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work.
- C. Waste Management Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Reclamation Programs: Research and prepare a plan to work with manufacturers who have programs to receive used materials. Known reclamation programs are available from, but not limited to, the following manufacturers:
 1. Carpet:
 - a. ReEntryProgram by Interface.
 - b. Antron, Invista.
 - c. CON-tinuum by Constantine & Covanta.
 - d. Local carpet and carpet cushion reclamation centers may be found on <http://www.carpetrecovery.org/>.
 2. Ceiling Panels: Armstrong World Industries, Inc.
 3. Resilient Flooring: ReUse Program by Tarkett.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within 3 days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 RECYCLING WASTE AND RECLAMATION

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from nonrecyclable waste materials, trash, and debris.
1. Provide appropriately marked containers or bins for controlling waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Designate separate on-site areas for recyclable waste and nonrecyclable materials, trash and debris.
 - b. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Maintain the facilities in an orderly condition.
 3. Cut all items to lengths and sizes to fit within the containers or bins provided.
 4. Where there is sufficient quantity of a specific recyclable debris item (for example; salvaged metal doors and frames or duct work), make arrangements for items to be bundled, banded or tied, and stack in a designated location for a special pick-up.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION 01 74 19

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Sections:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 5. Submit test/adjust/balance records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 7. Submit pest-control final inspection report.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - 6. Advise Owner of changeover in heat and other utilities.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 - 11. Complete repair and restoration operations.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.
- E. Certificate Form: AIA Document G704, Certificate of Substantial Completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.

- b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
- 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.
- 5. Additional copies: In addition to submission of electronic files, submit three paper copies.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with applicable State VOC restrictions.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

END OF SECTION 01 77 00

SECTION 017823

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. 3 paper copies (binder). Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form to Owner prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Owner will return copy with comments.
 - 1. Correct or revise each manual to comply with Owner's comments. Submit copies of each corrected manual within 5 days prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.

3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose electronic data available on compact disk media.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.

5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.

2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

END OF SECTION 01 78 23

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Sections:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Submit one set of marked-up record prints plus scanned PDF electronic file(s) of marked-up record Drawings.
- B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications plus scanned PDF electronic file(s) of marked-up record Specifications.
- C. Record Product Data: Submit one paper copy of each Product Data submittal plus scanned PDF electronic file(s) of marked-up record Product Data.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up record Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy plus scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note alternate numbers, Construction Change Directive numbers, Change Order numbers, and similar identification, where applicable.

- B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 - 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 - 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy plus scanned PDF electronic file(s) of marked-up paper copy of Specifications.
 - 1. Maintain format of original Project Manual organized sequentially by Specification Section number and title.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as paper copy plus scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Miscellaneous record submittals include, but are not limited to, the following:
 - 1. Certificates.
 - 2. Reports.
 - 3. Inspection data.
 - 4. Test results.
 - 5. Design data.
 - 6. Engineering analysis.
 - 7. Informational submittals.
- B. Format: Submit miscellaneous record submittals as paper copy plus scanned PDF electronic file(s) of marked-up paper copy of miscellaneous record submittals.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 017900

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1.4 CLOSEOUT SUBMITTALS

- A. Training Manuals: At completion of training, submit 3 complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.
 - 1. Electronic Copy: Provide copy of training materials in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.

- h. Performance curves.
- 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.

- b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least 7 days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
- 2. Demolition and removal of selected site elements.
- 3. Salvage of existing items to be reused or recycled.
- 4. Repair procedures for selective demolition operations.

B. Related Requirements:

- 1. Section 017300 "Execution" for cutting and patching procedures.
- 2. Section 017419 "Construction Waste Management and Disposal" for handling demolished materials.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Carefully detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Carefully detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be removed and salvaged, removed and reinstalled, or otherwise indicated to remain Owner's property, demolition waste becomes property of Contractor and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of proposed dust- and noise-control temporary partitions and barriers.
- C. Inventory: Submit a list of items to be removed and salvaged and delivered to Owner.
- D. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition selective operations. Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site prior to commencement of demolition operations. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Record significant conference discussions, agreements, and actions moving forward.
 - a. Reporting: Distribute minutes of the meeting to each party present, to parties who should have been present, and other interested parties.

1.7 FIELD CONDITIONS

- A. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner assumes no responsibility for condition of areas to be selectively demolished.
 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- G. Maintain fire-protection facilities and life safety systems in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible and that are approved by Architect.
 2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed or Relocated: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed or relocated, before proceeding with selective demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - a. All temporary bypass utilities must be reviewed and approved, in writing, by Owner prior to placing in service.
 - 3. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- C. Refer to Mechanical and Electrical Drawings and Specifications for additional requirements for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed.

3.3 PROTECTION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 3. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
 1. Erect temporary fire barriers as required to maintain the continuity of existing fire enclosures and to prevent the possibility of fire spread at areas affected by selective demolition.
- E. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of

construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
- F. Remove temporary barricades and protections where hazards no longer exist.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
1. Do not use water (mist) when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials.
 - a. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations.
 - b. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - c. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 8. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."

9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
10. Cutting and patching procedures: Comply with requirements specified in Section 017300 "Execution."

B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
- F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
 1. Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.7 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with patching requirements specified in Section 017300 "Execution."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 031000

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-in-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 347 – Guide to Formwork for Concrete.
6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company specializing in the type of concrete formwork required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.

- B. Contractor's Testing Agency Services: Required as specified in Division 1, and herein.
- C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Formwork Shop Drawings
- (3) Hazardous Materials Notification

1. **Submittal Schedule:** See Section 033000.

2. **Formwork Shop Drawings:**

- a) Submit for record: Formwork shop drawings sealed and signed by a registered Design Professional licensed to practice as a Professional Engineer in the state where the project is located. Shop drawings shall clearly indicate but not be limited to the following:

- 1. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
- 2. Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents

- b) Submit for Review

- 1. Location of proposed construction joints in walls, floors, per Specification Section 033000.

3. **Hazardous Materials Notification:** Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process: See Section 033000

C. SER Submittal Review: See Section 033000

D. Substitution Request: See Section 033000

E. Request for Information (RFI): See Section 033000

1.7 FORMWORK DESIGN

- A. Design of Formwork, Shoring/Reshoring, and its removal is the Contractor's responsibility.
- B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.
- C. Design Requirements:
 - 1. Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of ACI 301, 318 and 347.
 - 2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Section 3.2 for shoring/reshoring requirements.
 - 3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
 - 4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1, including the following:
 - 1. Store forms and form materials clear of ground and protect from damage.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete formwork as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.
- B. Testing Agency shall provide qualified personnel at site to inspect formwork using the latest Contract Documents and approved shop drawings as follows:
 - 1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect suitability of concrete placement and tolerances stated herein.
 - 2. Inspect forms for location, configuration, compliance with specified tolerances, block outs, camber, shoring ties, seal of form joints and compliance with Contract Documents.

3. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
 4. Verify proper use/application of form release agents.
 5. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.
- C. Owner's Testing Agency shall submit inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete formwork conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
- D. Immediately report deficiencies to the Contractor, Owner and Design Professionals.
- 1.10 QUALITY CONTROL BY CONTRACTOR
- See Section 033000.
- 1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS
- See Section 033000.
- 1.12 PERMITS AND WARRANTY
- A. Permits: See Section 033000.
- B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:
1. Discoloration of concrete scheduled to remain exposed to view.
 2. Damage of concrete finishes caused by forms.
 3. Damage of concrete caused by form stripping.
 4. Non-compliance with form finishes required for designated architectural finishes.
 5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
 6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.
- B. Substitutions: Comply with General Conditions using form in Division 1.

2.2 FORMWORK REQUIREMENTS

- A. General Requirements:

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Concrete Formwork
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1. Formwork shall meet construction safety regulations for locality in which this Project is located.
2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
3. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).
 - a) Class C – General Standard for permanently exposed surfaces where other finishes are not specified.
 - b) Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.
4. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, using form materials with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
5. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

2.3 FORM MATERIALS

- A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.
 1. Provide materials with sufficient strength to prevent warping.
- B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.
 1. Other Acceptable Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.
- C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.
 1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.
- D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.
 1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.
- F. Chamfer for Form Corners:

1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" (20mm) size, maximum possible lengths.
2. Required for all exposed corners of beam, walls and column forms.

G. Form Ties:

1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Ties used for architecturally exposed concrete shall be galvanized.
3. Ties shall not leave metal closer than 1-1/2" (40mm) to exposed surface.
4. When removed, ties shall not leave holes larger than 1" (25mm) diameter in concrete surface.
5. Removable Ties: Use type with tapered cones, 1" (25mm) outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
7. Wire Ties: Not acceptable.

H. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:

1. Type: Of size, strength and quality to meet the required quality of formwork.

I. Form Release Agent:

1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.
2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).
3. For Steel Forms: Non-staining rust-preventative type.

J. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge (0.55mm) galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

K. Coordinate with materials as specified in Section 032000/Concrete Reinforcement and Embedded Assemblies.

PART 3 - EXECUTION

3.1 FORMWORK

A. General:

1. Inspect areas to receive formwork.
 - a) Immediately report to Owner's Testing Agency and Design Professionals in writing the conditions that will adversely affect the Work.
 2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
 3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
 4. Provide for offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
 5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
 6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
 7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
 8. Erect forms for easy removal without hammering or prying against concrete surfaces.
 9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
 10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
 11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
 12. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
 13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
 14. Where specifically shown on the Contract Documents as monolithic, upturned beams, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.
- B. Concrete Accessories and Embedded Items:
1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.
 - a) Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.
 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at

- exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
 - 4. Coordinate with Section 032000/Concrete Reinforcement and Embedded Assemblies.
 - 5. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.
- C. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.
- 1. Determine size and location of recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
 - 2. Accurately place and securely support items built into forms.
- D. Cleaning:
- 1. Normal Conditions:
 - a) Thoroughly clean forms and adjacent surfaces to receive concrete.
 - b) Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.
 - c) Flush with water or use compressed air to remove remaining foreign matter.
 - d) Verify that water and debris can drain from forms through clean-out ports.
 - 2. During Cold Weather:
 - a) Remove ice and snow from within forms.
 - b) Do not use de-icing salts.
 - c) Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
 - d) Use compressed air or other means to remove foreign matter.
- E. Form Release Agents
- 1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
 - 2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.
 - a) Coat steel forms with nonstaining, rust-preventative material.
 - 3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.
- F. Before Placing Concrete:

1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.
 - a) Make necessary corrections or adjustment to formwork to meet tolerance requirements.
 2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
 3. Notify Owner's Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.
- G. During Concrete Placement:
1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
 2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.
- H. Surface Defects:
1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.
- I. Formwork Loads on Grade
1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.
- J. Footings:
1. Provide forms for footings if soil or other conditions are such that earth trench forms are unsuitable.
 2. When trench forms are used, provide an additional 1" (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.
 3. **Earth forming of concrete elements is not acceptable.**
- 3.2 REMOVING FORMS
- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at

least 75% of design compressive strength as proven by cylinder test. If stripping occurs before **3** days, 100% strength must be achieved.

1. Provide reshores as required per ACI 347.
 2. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.
- D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- E. Reshore structural members where required due to design requirements, construction requirements, or construction conditions.
1. Reshore on same day shoring and forms are removed.
- F. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 033000.
- G. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.
- H. Form tie holes shall be filled as per approved samples submitted to the Architect and Engineer.
- I. The Contractor shall assume responsibility for all damage due to removal of the forms.

3.3 RE-USING FORMS

- A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.
1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
 2. Apply new form release agent on re-used forms.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.
- C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

3.4 CORRECTIVE MEASURES

- A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 032000

CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Formwork	Section 031000
Cast-in-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
6. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. AWS D1.1 – Structural Welding Code-Steel.
9. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

10. CRD C 572 – Specification for Polyvinylchloride Waterstops.
11. Concrete Reinforcing Steel Institute "Manual of Standard Practice"
12. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a fabricator specializing in the type of reinforcement fabrication required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

1. Welders shall be qualified in accordance with applicable AWS Code within 12 months before starting the work.

- a) Make qualification records available to the Design Professionals upon request.

- B. Manufacturers shall specialize in manufacturing the types of concrete accessories required for cast-in-place concrete work, with a minimum of 10 years of documented successful experience and shall have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of accessory.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- (1) Submittal Schedule
- (2) Shop Drawings
- (3) Product Data
- (4) Mill Reports
- (5) Hazardous Materials Notification
- (6) LEED Submittals

1. **Submittal Schedule:** See Section 033000.
2. **Shop Drawings:** Submit shop drawings that shall clearly indicate, but not be limited to:
 - a) All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
 - b) Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.

- c) Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
 - d) Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.
 - i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.
 - ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.
 - e) Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
 - f) Each type of supporting and spacing devices, including miscellaneous accessories.
 - g) Construction joint type, details and locations. Contractor shall coordinate with concrete pour schedule and submit for action by the Design Professionals.
 - h) Submit comprehensive (a single drawing per area/element) layout/placement drawings. Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor. Submit with or prior to reinforcement submittal for same element/area. Drawings shall include:
 - i. Concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement.)
 - ii. Opening in structural members, including floor slab, shearwalls, columns and beams.
3. **Product Data:** Submit for approval for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. **Mill Reports:** Submit for record.
5. **Reinforcement Strain Test:** For Grade 75 reinforcement, submit for record certification that steel has a yield strength of no less than 75 ksi as measured by both ASTM A615 and ACI 318 Section 3.5.3.2 procedures.
6. **Hazardous Materials Notification:** Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
- B. Submittal Process: See Section 033000
- C. SER Submittal Review: See Section 033000

- D. Substitution Request: See Section 033000
- E. Request for Information (RFI): See Section 033000

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions and Division 1, including the following:
 - 1. Deliver reinforcing steel to Project site bundled, tagged and marked.
 - a) Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.
 - 2. Deliver welded wire fabric in sheets. Do not deliver in rolls.
 - 3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
 - 4. Deliver and store welding electrodes in accordance with AWS D1.4.
 - 5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
 - 6. Store reinforcing steel above ground so that it remains clean.
 - a) Maintain steel surfaces free from materials and coatings that might impair bond.
 - b) Keep covered.
 - c) Protect against corrosion or deterioration of any kind.

1.8 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete reinforcement and embedded assemblies as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professionals for final acceptance.
- B. Owner's Testing Agency shall provide qualified personnel at the site to inspect reinforcement, embedments, and accessories using the latest Drawings and reviewed shop drawings, as follows:
 - 1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
 - 2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
 - 3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
 - 4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.

C. Adhesive anchors shall be proof tested in tension as follows:

1. The Owner's Testing Agency shall submit an adhesive anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
2. Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
3. Testing shall be performed after the minimum curing period specified by the manufacturer.
4. **5** percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by the Owner's Testing Agency.
5. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
6. The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
7. Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
8. If more than **10%** of the tested adhesive anchors fail to achieve the specified proof load, **100%** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Notify the SER of all failed proof tests.

D. Mechanical post-installed anchors shall be proof tested as follows:

1. The Owner's Testing Agency shall submit a mechanical anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
2. **5** percent of each type and size of mechanical anchor shall be proof tested by the Owner's Testing Agency. The required proof test for the anchors is as follows:
 - a) For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
3. The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.
4. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.

5. Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
 6. If more than **10%** of the tested mechanical anchors fail to achieve the specified proof torque load or set, **100%** of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Notify the SER of all failed proof tests.
- E. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in section B.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:
1. Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
 2. Anchor spacing and edge distance.
 3. Hole diameter and depth.
 4. Hole cleaning in accordance with the MPII.
 5. Anchor element type, material, diameter, and length.
 6. For adhesive anchors, adhesive identification and expiration date.
 7. For adhesive anchors, adhesive installation in accordance with the MPII.
 8. For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.
- F. Owner's Testing Agency shall submit inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete reinforcement, embedded assemblies, and post-installed anchors conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
- G. Immediately report deficiencies to the Contractor, Owner and Design Professionals.
- 1.9 QUALITY CONTROL BY CONTRACTOR
- See Section 033000.
- 1.10 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS
- See Section 033000.
- 1.11 PERMITS AND WARRANTY
- A. Permits: See Section 033000.
- B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:

1. Bars with kinks or bends not indicated on Drawings or on approved shop drawings.
2. Bars damaged due to bending, straightening or cutting.
3. Bars heated for bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 or 75 as indicated on Drawings.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
 - a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Epoxy-Coated: ASTM A 775 where indicated on Drawings.
5. Weldable reinforcement: ASTM A 706 where indicated on Drawings.

B. Welded Wire Reinforcement:

1. Type: steel wire, plain finish, ASTM A 82.
2. Type: steel wire, deformed, ASTM A 496.
3. Size: As indicated on structural Drawings.
4. Where indicated on Drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
 - a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
5. Plain Steel Welded Wire Reinforcement: ASTM A 1064.
6. Deformed Steel Welded Wire Reinforcement: ASTM A 497.
7. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

C. Shear Reinforcement At Slab-Column Connections:

1. Type: Steel studrail assemblies for shear reinforcement at slab-column connections shall be DECON STUDRAILS supplied by DECON USA, Medford New Jersey.
 - a) Shear studs shall be in accordance with ASTM A108, Grade C1015.
 - b) Rails shall be low carbon steel Type 44W.
 - c) Studs shall be welded in accordance with AWS D1.1.

2. Size: As indicated on structural Drawings.
3. Installation: Per manufacturer's instructions.
4. Supports: Use plastic molded plastic chairs as provided by the manufacturer to maintain the bottom rebar cover as specified on the Drawings. Tie studrails to adjacent top bars to maintain vertical position.

D. Reinforcement Coating Repair Materials:

1. Apply repair coating in accordance with the manufacturer's written procedures.
2. Galvanized Repair Coating: Zinc-based solder, paint containing zinc dust or sprayed zinc complying with ASTM A780.
3. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/ A 775M.
 - a) The maximum amount of repaired damaged areas shall not exceed 2% of the surface area in each linear foot of each bar. If more than 2% of the surface area in each linear foot of bar is damaged, bar shall be replaced.

2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option. For seismic design categories D, E and F, in plastic hinge regions, only Type 2 mechanical splices are permitted.
2. Acceptable Products: Bartec Couplers by Dextra, Santa Fe Springs, CA or Lenton Cadweld by Erico, Solon, OH or Bar Lock coupler system by Dayton Superior, Miamisburg, OH or Grip-Twist by Bar Splice, Dayton, OH or ZAP Screwlok by Bar Splice, Dayton, OH or Lenton Couplers by Erico, Solon, OH. Splices shall be installed in compliance with manufacturer's requirements.
3. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
4. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:

1. For bar sizes #11 (Ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used.

2. Acceptable Products: Bartec End Anchors by Dextra, Santa Fe Springs, CA or Lenton Terminator by Erico, Solon, OH or Grip-Twist Doughnut by Bar-Splice, Dayton, OH or Bar Lock End Anchorage System by Dayton Superior, Miamisburg, OH.
- D. Supports for Reinforcement:
1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
 2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.
 - a) Plastic tips shall extend not less than 1/2" (12mm) on metal legs.
 3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
 4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.
 5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.
- E. Deformed Bar Anchors:
1. Type: Automatic end welded, ASTM A 496 quality.
 2. Size and Grade: As indicated on structural Drawings by Nelson Stud Welding.
- F. Anchor rods and dowels:
1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.
 2. Adhesive Anchors for anchor rods and dowels in existing concrete: See Anchorage Accessories.
- G. Prefabricated Bent-In Dowel Keyway System:
1. Type, Size and Grade as indicated on Drawings.
 2. Acceptable Products: Lenton Form Savers by Erico, Solon, OH or Stabox by Meadow Burke, Tampa, FL or Metalstrip by Dayton Superior, Miamisburg, OH.
 3. Installation: Per Manufacturer's instructions.

2.3 ANCHORAGE ACCESSORIES

- A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:
1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
 2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
 3. Threaded Inserts: Manufactured by Dayton/Richmond Screw Anchor Co. or Powers Fasteners, Inc.
 4. Adhesive Anchors:
 - a) Basis of Design: See General Notes
 - b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure
 - i. HIT-RE 500-SD by Hilti, Inc., Tulsa, OK
 - c) The adhesive anchor system used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.4 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
 5. Expansion Anchors:
 - a) Basis of Design: See General Notes
 - b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
 - i. Power Stud+ SD1 or SD2 by Powers Fasteners, Brewster, NY
 - ii. Power Stud + SD6 (SS) by Powers Fasteners, Brewster, NY
 - iii. Trubolt or Trubolt+ by ITW Red Head, Glendale Heights, IL
 - iv. Strong-Bolt by Simpson Strong-Tie Co., Pleasanton, CA
 - c) The expansion anchors used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.2 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
 6. Threaded Screw Anchors:
 - a) Basis of Design: See General Notes
 - b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
 - i. Wedge Bolt+ by Powers Fasteners, Brewster, NY
 - ii. Tapcon by ITW Red Head, Glendale Heights, IL

iii. Titan HD by Simpson Strong-Tie Co., Pleasanton, CA

7. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior, Dayton, OH.
8. Welding Electrodes: AWS 5.5, Series E70.
9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.

B. Dovetail Anchor Slots:

1. Type: Formed 22 gauge (0.85mm) galvanized steel manufactured by Heckmann Building Products, Chicago, Illinois or Hohmann and Barnard, Hauppauge, New York or Pro-Slot by BoMetals, Inc., Carrollton, GA.
2. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.
3. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
4. Finish: Hot-dip galvanized or zinc-plated steel.
5. Stainless steel anchors are acceptable.

2.4 JOINT FILLERS

A. Permanent Compressible Joint Filler:

1. Type: W. R. Meadows: "Ceramar" closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants.
2. Location of Use: Slabs and curbs as indicated on Drawings or required.
3. Thickness: As indicated on Drawings or required.

B. Temporary Compressible Joint Filler:

1. Type: White molded polystyrene beadboard.
2. Location of Use:
 - a) In slabs, curbs, and walls which must be removed prior to joint sealant installation.
 - b) Vertically to isolate walls from columns or other walls.

C. Semi Rigid Joint Filler:

1. Acceptable Product: Euclid Chemical Company "Euco 700" or "Euco QWIKjoint 200"
2. Acceptable Product: Sika Corporation "Sikadur 51 SL"
3. Acceptable Product: W.R. Meadows Sealtight "Rezi-Weld Flex"

D. Noncompressible Joint Filler:

1. Type: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi (275kPa) compressive strength, ASTM C 578, Type IV.
 2. Thickness: As indicated on Drawings.
 3. Location of Use: As indicated on Drawings or required.
- E. Asphalt-Impregnated Joint Filler:
1. Type: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994.
 2. Thickness: ½" (12mm) maximum, as indicated on Drawings or required.
 3. Location of Use: Sidewalks at foundation walls and as indicated on Drawings or required.
- F. Asphalt-impregnated fiberboard expansion joint filler for interior work:
1. Type: ASTM D1751.
- G. Self-expanding cork board expansion joint filler for exterior work:
1. Type: ASTM D1752.
- H. Construction Joints:
1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" (150mm) on center to receive dowelling, complete with anchorage.

2.5 WATERSTOPS

- A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.
1. Acceptable Products:
 - a) "Volclay Waterstop RX" by CETCO Building Materials Group, Hoffman Estates, IL
 - b) "Adcor ES" by W. R. Grace & Co., Cambridge, MA
 - c) "Hydrotite" by Sika, Lyndhurst, NJ
 2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
 3. Location of Use: Concrete cold joints at footings, walls and slab joints.
 4. Comply with manufacturer product application and installation instructions.
- B. Polyvinyl Chloride Waterstops:
1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
 2. Acceptable Products:

- a) "PVC Waterstops" by BoMetals, Carrollton, GA
- b) "Greenstreak" by Sika, Lyndhurst, NJ
- c) "Sealtight PVC Waterstops" by W.R. Meadows, Hampshire, IL

PART 3 - EXECUTION

3.1 FABRICATION

A. Reinforcing Steel Fabrication:

- 1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
- 2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
- 3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
- 4. Tolerances: Comply with ACI 117.
- 5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.
 - a) Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
 - b) Bends or kinks not indicated on Drawings or final shop drawings.
 - c) Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:

- 1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:

- 1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:

- 1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
- 2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries or Tru-Weld Stud Welding, Medina, OH.
- 3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Owner's Testing Agency.
- 4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.

5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

3.2 INSTALLATION OF REINFORCEMENT

A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by Owner's Testing Laboratory.
5. Reinforcement steel is not permitted to be "floated into position".
6. Bend bars cold.
 - a) Do not heat or flame cut bars.
 - b) No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Independent Testing Agency for cracks.
7. Weld only as indicated.
 - a) Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
 - b) See structural Drawings for additional requirements.
8. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.
 - a) Place reinforcement bars within tolerances specified in ACI 117.
 - b) Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.
3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
 - a) Repair damages before placing concrete.

5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:

1. Install in lengths as long as practicable.
2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
3. Overlap the wire reinforcement 6" (150mm) or one panel width + 2" (50mm), whichever is larger.
 - a) Securely tie together with wire.
4. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.

D. At Construction Joints:

1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.

E. At Expansion Joints:

1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on Drawings.

F. Splicing:

1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 (Ø36) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
2. At all #14 (Ø43) and #18 (Ø57) bars and where mechanical splices are specifically indicated on Drawings, comply with requirements specified in this Specification section under "Mechanical Splicing Systems".
3. Do not splice reinforcement except as indicated on structural Drawings.
4. Tension couplers may be used and installed per manufacturer's specifications where indicated on Drawings or as approved by Engineer.

G. Dowels in Existing Concrete:

1. Install dowels and dowel adhesive in accordance with supplier's recommendations.
2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

3.3 INSTALLATION OF POST-INSTALLED ADHESIVE ANCHORS

A. General:

1. Post-installed adhesive anchors shall be installed in accordance with the Manufacturer's Printed Installation Instructions (MPII).
2. The adhesive anchors shall be supplied as an entire system. The contractor shall provide all equipment required to install the adhesive anchor in accordance with the MPII.
3. Anchors shall be installed in holes drilled with a rotary impact hammer drill with carbide bit. Contractor shall obtain written approval from SER prior to using rock drilling or core drilling installation methods.
4. Anchor holes shall be thoroughly cleaned prior to adhesive injection, in accordance with the MPII. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings
5. Concrete shall have a minimum compressive strength of 2500 psi (17MPa).
6. Concrete at time of adhesive anchor installation shall have a minimum of 21 days.
7. Concrete temperature at the time of adhesive anchor installation shall be at least equal to manufacture's requirements, or 50° F (10°C) if no requirement exists.
8. Support the anchor and protect it from disturbance or loading for the full cure time stated by the manufacturer at that base material temperature.
9. Unless specified otherwise in the contract documents, anchors shall be installed perpendicular to the concrete surface. Anchors displaced or disturbed prior to the adhesive cure time shall be considered damaged and reported to the SER (see Observations and Corrections section of 033000).
10. Locate, by non-destructive means, and avoid all existing reinforcement prior to installation of anchors. If existing reinforcement layout prohibits the installation of anchors as indicated in the drawings the contractor shall notify the Design Professionals immediately.
11. Reinforcement bars or all-threaded bars shall not be bent after being adhesively embedded in hardened, sound concrete, unless written approval is given by the SER.
12. All personnel installing anchors shall be trained by the manufacturer on proper installation techniques. Submit for record certificate from training documentation from the manufacturer for each installer on this Project
13. Installation of adhesive anchors horizontally or upwardly inclined and anchors that are designated with a (CERT) after the anchor call-out, shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program. Submit for record certificate from ACI-CRSI Adhesive Anchor Installation Certification Program for each certified installer on this Project.

3.4 INSTALLATION OF ACCESSORIES

- #### A.
- Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.

1. Set and secure embedments, including embedded plates, bearing plates, and anchor bolts, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
 2. Inspect locations to receive concrete accessories.
 3. Immediately report to the Design Professionals in writing of conditions that will adversely affect the Work or fails to meet Contract Document requirements.
 4. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Owner's Testing Agency.
- B. Construction and Contraction (Control) Joints:
1. Construction and contraction (control) joints indicated on Drawings are mandatory and must not be omitted.
 - a) Provide construction joints in accordance with ACI 318.
 - b) Roughen surface at construction joints as indicated on the drawings.
 - c) Where specifically indicated on drawings, provide 1-1/2" (40mm) deep key type construction joints at end of each placement for slabs, beams, walls and footings.
 - i. Bevel forms for easy removal.
 2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
 3. Install waterstops to form continuous diaphragm in each joint.
 4. Support and protect exposed waterstops during progress of Work.
 5. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

3.5 CORRECTIVE MEASURES

- A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This Specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Formwork	Section 031000
Concrete Reinforcement and Embedded Assemblies	Section 032000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. American Concrete Institute "Manual of Concrete Practice", various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

C. Definitions:

Ramapo College of New Jersey
College Commons
RCNJ Project 12-281C

Cast-in-Place Concrete
033000 - 1

1. The term "Contract Documents" in this Specification is defined as the design Drawings and the specifications.
2. The term "SER" in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term "Design Professionals" in this Specification is defined as the Owner's Architect and SER.
4. The term "Contractor" in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.
5. The term "Testing Agency" in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms "for record" and "submit for record" in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. Working Days: Monday through Friday, excluding federal or state holidays.

1.5 CONTRACTOR QUALIFICATIONS

- A. The work of this section shall be performed by a company specializing in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.
- B. Contractor's Testing Agency Services: Required as specified in Division 1, and herein.
- C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted.

- (1) Submittal Schedule
- (2) Mix Designs
- (3) Hot and Cold Weather Procedures
- (4) Product Data
- (5) Concrete Joint Locations
- (6) Preconstruction Survey
- (7) Survey of Flat Plate or Flat Slab Concrete Floors during construction
- (8) Survey of As-built Floor Conditions
- (9) Survey of As-built Column and Wall Conditions
- (10) Structural Repairs

- (11) Patching Defective Concrete Finishes
- (12) Conduit and Pipes Embedded in Concrete
- (13) Hazardous Materials Notification
- (14) LEED Submittals

Submittal Schedule: The contractor shall submit for approval a schedule at least twenty (20) working days prior to commencing submittals.

- a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for approval at least twenty (20) working days before the modification or addition is proposed to take place.
- b) If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
- c) For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.

2. **Mix Designs:** Submit concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.

- a) Mix designs shall be prepared or reviewed by an approved independent Testing Agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, signed by a registered Design Professional licensed to practice as a Professional Engineer in the state where the project is located, and shall be coordinated with design requirements and Contract Documents.
- b) Before submitting to Owner's Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
- c) Provide a completed "Concrete Mix Design Submittal Form" (attached to the end of this Specification Section) for each proposed concrete mix.
- d) Data shall be from the same production facility that will be used for this Project.
- e) Mix Design data shall include but not be limited to the following:
 - i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.

- ii. Design Compressive Strength: As indicated on the Drawings.
- iii. Proportions: ACI 301 and ACI 318.
- iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
- v. Water/cementitious material ratio.
- vi. Evaluate and classify fly ash in accordance with ASTM D 5759.
- vii. Report chemical analysis of fly ash in accordance with ASTM C 618.
- viii. Classify blast furnace slag in accordance with ASTM C 989.
- ix. Slump: ASTM C 143.
- x. Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218.
- xi. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
- xii. Unit Weight of Concrete: ASTM C 138.
- xiii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.
 - (1) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by Water-Cement Ratio is not permitted.
 - (2) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.
 - (3) If early concrete strengths are required, Contractor shall submit trial mixture results as required.
- xiv. Test records to support proposed mixtures shall be no more than 24 months old and use current cement and aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.
- xv. Manufacturer's product data for each type of admixture.
- xvi. Manufacturer's certification that all admixtures used are compatible with each other.
- xvii. All information indicating compliance with Contract Documents including method of placement and method of curing.
- xviii. Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
- xix. Certification from a qualified testing agency indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity in accordance with ASTM C 33

3. **Hot and Cold Weather Procedures:** Submit for record to Design Professional's written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
4. **Product Data:** Submit product data clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility and limitations for each of the following:
 - a) Bonding agents.
 - b) Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
 - c) Absorptive covers and moisture retaining covers.
 - d) Vapor Retarder: See Division 7, Thermal and Moisture Protection.
 - e) Self-leveling concrete topping.
 - f) Grout: Submittal of Grout not by manufacturers listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
 - g) Other products proposed by Contractor
5. **Concrete Joint Locations:** Submit plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.
6. **Preconstruction Survey:** Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
7. **Structural Repairs:** Submit procedures and product information. Alterations to design shall be signed & sealed by a licensed **[Professional, Structural]** engineer in the state in which the project is located.
8. **Patching Defective Concrete Finishes:** Submit procedures and product information.
9. **Conduit and Pipes Embedded in Concrete:** Submit for approval layout of embedded conduit and pipes.

10. **Hazardous Materials Notification:** Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable Drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals **two (2) black line prints and one (1) electronic copy]** for shop drawing review. If the Contractor and Design Team agree to process shop drawings electronically, Contractor shall submit one hardcopy and one electronic copy to the SER. The naming convention of each drawing must follow the submittal numbering system and include the submittal number, Specification number, revision number and drawing number in the prefix of the drawing name.
4. The Contractor shall allow at least **ten (10)** working days between receipt and release by the SER for the review of shop drawings and submittals.
5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
 - a) Failure to specifically cloud modifications
 - b) Unapproved revisions to previous submittals
 - c) Unapproved departure from Contract Documents
6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
7. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to Contractors' errors. The Contractor shall compensate the Design Professionals at standard billing rates plus out-of-pocket expenses incurred at cost + 10%.
8. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:
 - a) Conforming to the Contract Documents.
 - b) Coordination with other trades.
 - c) Responsibility for all required detailing and proper fitting of construction work.
 - d) The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
 - e) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.
2. TYPE 1 Stamp - For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require the following actions:
 - a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
 - b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
 - c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
 - d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
3. TYPE 2 Stamp - For submittals for building elements which are not designed by the SER but are performance specified, for items that do not form part of the completed structural system but impose loads on the structure, and

for construction items or activities which have an effect on the final structure, a second stamp will be used. The responses on the stamp used by the SER require the following actions:

- a) NO EXCEPTION TAKEN indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
- b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
- c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

- 1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
- 2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
- 3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
- 4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
- 5. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for

testing and inspection by the Owner shall also be compensated by the Contractor.

6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)

1. RFIs shall be submitted by the Contractor. RFIs submitted by other entities will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.
 - a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:
 - i. No cost clarification
 - ii. Shown in Contract Documents
 - iii. Change to be issued in future document revision
 - iv. Previously answered
 - v. Information needs to be provided by others.
 - vi. Request for corrective field work
 - vii. Request for substitution
 - b) RFIs in categories 1, 2, 3, 4 and 5 will be turned around by the SER on average of **five (5)** working days.
 - c) RFIs in categories 6 and 7 will be rejected and must be submitted as submittals or requests for substitution.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1.

B. Storage:

1. Store materials in accordance with ACI 304R.
2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminants.
3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.

C. Handling:

1. Handle fine and coarse aggregates as separate ingredients.

2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
3. Do not use frozen or partially frozen aggregates.
4. Allow sand to drain until it has reached relatively uniform moisture content before use.
5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-INSTALLATION CONFERENCE

- A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the approved concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:
 1. Contractor.
 2. Owner's Testing Agency representative
 3. Concrete Subcontractor.
 4. Ready-mix concrete producer.
 5. Admixture manufacturer(s).
- B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:
 1. Design Professionals.
 2. Owner's Representative.
- C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these Specifications.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance.
- B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.
- C. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the testing agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owner's Testing Agency in the performance of their work and shall provide the following:

1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work
2. Site File: At least one copy of each approved shop drawing shall be kept available in the Contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job.
3. Full and ample means of assistance for testing and inspection of material
4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field

D. Duties of the Owner's Testing Agency:

1. Reports: The Testing Agency shall prepare daily reports of the concrete work including progress and description/area of work, tests made and results. The daily reports shall be collected and delivered to the Design Professionals and Owner weekly. Rejection: The Owner's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall report deficiencies to Owner, Design Professionals, and Contractor immediately.
2. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Owner on a weekly basis.
3. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and Specification requirements.

E. Field Quality Assurance

1. General: The Owner's Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professional for final acceptance.
2. Owner's Testing Agency is responsible for monitoring concrete placement as follows:
 - a) Owner's Testing Agency shall provide qualified personnel at site to monitor concreting operations as follows:
 - i. Verify use of required design mix
 - ii. Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
 - iii. Record temperature of concrete at time of placement.
 - iv. Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
 - v. Record types and amounts of admixtures added to concrete batches, including that added after departure of concrete trucks from batch plant at the project site.

- vi. Record amounts of and monitor dosing of high-range water-reducing admixtures added at site for site-added admixtures and redosing for plant-added admixtures.
 - vii. Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.
 - viii. Monitor consistency and uniformity of concrete.
 - ix. Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
 - (1) Concrete curing.
 - (2) Hot weather concreting operations.
 - (3) Cold weather concreting operations.
3. Owner's Testing Agency shall conduct tests of concrete as follows and in accordance with ASTM C 1077:
- a) Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each **50** cubic yards. (**40** cubic meters) of concrete, nor less than once for each **2500** square feet (**250** square meters) of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals.
 - b) Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.
 - c) Determine air content of normalweight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173.
 - d) Determine unit weight of normalweight concrete in accordance with ASTM C 138 and lightweight concrete in accordance with ASTM C 567.
 - e) Conduct one test for air content for each strength test required or for every 50 cubic yards (40 cubic meters) of fly ash concrete placed, whichever is less. Test in accordance with ASTM C 173 or ASTM C 231.
 - f) The water content of freshly mixed concrete will be tested on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
 - i. Architecturally exposed hard troweled slabs
 - ii. Slab to receive a bonded finish floor material
 - iii. Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)
 - g) Conduct slump tests in accordance with ASTM C 143.

- h) Conduct slump tests for concrete enhanced with high-range water-reducing admixtures as follows:
 - i. Concrete with plant added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site. Batches delivered to site with slumps in excess of the range defined in the mix design submittal or with excessive segregation as defined in the ACI Manual of Standard Practice Part I shall be rejected.
 - ii. Concrete with site added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site and after addition of high-range water-reducing admixtures for conformance to initial water slump and final slump requirements.
 - iii. Concrete shall also be sampled at point of initial discharge for conformance to slump and/or slump-flow requirements. Visually observe slump-flow at point of concrete placement. If slump loss is visually observed to exceed the range specified for mix design, perform additional slump test at point of discharge from concrete pump hose.
- i) Conduct slump tests for Self Consolidating Concrete (SCC) as follows
 - i. In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Engineer and Ready Mix Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.
 - ii. In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be reportioned at the direction of the Engineer and Ready Mix Quality Control Representative.
- j) Conduct strength tests of concrete as follows:
 - i. Secure sample sets in accordance with ASTM C 172.
 - ii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of

- cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f'_c .
- iii. Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.
 - iv. For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - v. For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - vi. For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.
 - vii. When high early strength concrete is required by Contractor, additional cylinders shall be made and tested as required at Contractor's expense.
 - viii. If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.
4. Owner's Testing Agency shall evaluate concrete for conformance with Specifications as follows:
- a) Strength test:
 - i. Owner's Testing Agency shall maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in Work.
 - ii. Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).
 - iii. If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER,

be subject to further evaluation by core testing as specified herein.

- b) Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.
 - i. Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.
 - ii. Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.
 - iii. Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
- c) Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.

- 5. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Owner's Testing Agency, and prior to the removal of shores and forms.

- F. Owner's Testing Agency shall submit inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete placement conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
- G. Immediately report deficiencies to the Contractor, Owner and Design Professionals.

1.10 QUALITY CONTROL BY CONTRACTOR

- A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.
- B. The Owner's general review during construction and activities of the Owner's Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
- C. The Contractor shall immediately report to the Design Professionals any deficiencies in the work which are departures from the Contract Documents. The

Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

- D. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
- B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this specification.

1.12 PERMITS AND WARRANTY

- A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.
- B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:
 - 1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
 - 2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
 - 3. Areas which show surface failure or defects.
 - 4. Areas which puddle water.
 - 5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have the Owner's Testing Agency perform appropriate tests for bond and discoloration.
 - 6. Patches that become crazed, cracked or sound hollow when tapped.
 - 7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS & PRODUCTION

A. Portland Cement:

1. ASTM C150, Type I or Type II
2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of Structural Engineer. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.

B. Aggregates for Normalweight Concrete:

1. ASTM C 33
2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
3. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
4. Do not use fine or coarse aggregates that contain substances that cause spalling.
5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:

Size no. 57 (25mm max) for footings, drilled piers and caissons
Size no. 67 (20mm max) for all other locations
Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.
6. Contractor shall furnish concrete with maximum 3/8" (10mm) aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.

C. Aggregates for Lightweight Concrete:

1. ASTM C 330.
2. Classification of Aggregates: As required to meet Design Professional's requirements.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed 3/4" (20mm)

D. Water: ASTM C 94. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.

E. Supplementary Cementitious Material

1. Fly Ash:

- a) ASTM C 618, Class C or Class F.
 - b) Shall not be used unless part of an approved mix design.
 - c) Limit Loss on Ignition to 2.5%
2. Ground Granulated Blast-furnace Slag (GGBFS)
- a) ASTM C 989.
 - b) Shall not be used unless part of an approved mix design.
3. Silica Fume (Microsilica):
- a) ASTM C 1240
 - b) Acceptable Product: W. R. Grace "Force 10,000 D"
 - c) Acceptable Product: Euclid Chemical Company "Eucon MSA"
 - d) Acceptable Product: BASF "MasterLife SF 100"
 - e) Acceptable Product: Sika Corporation "Sikacrete 950 DP"
4. For concrete subject to Exposure Class F3 conditions as defined in ACI 318, Table 4.2.1, limit the maximum content of supplementary cementitious materials to values shown in ACI 318, Table 4.4.1.
5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.
6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.
7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.
- F. Ready Mixed Concrete:
1. Shall be batch-mixed and transported in accordance with ASTM C 94.
- G. Self-Consolidating Concrete:
1. Produce in accordance with ACI 237R.
2. Perform the following tests and provide report prior to submitting mix design:
- a) Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.
 - b) Slump Flow: ASTM C 1611 within a range of **[20"-30" (500mm-750mm)]**.
 - c) Passing Ability: ASTM C 1621 with a maximum difference of 2" (50mm) between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals (Exposure Classes F1, F2, F3), and concrete intended to be watertight, provide entrained air content of $6\% \pm 1.5\%$, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
 - a) Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
 - b) Concrete in parking garages.
 - c) Ramps and loading docks.
 - d) Balconies and terraces with no waterproof membrane.
2. For lightweight concrete less than 120 pcf (19 kN/m^3) density, air content may be up to 7% regardless of exposure condition.
3. For concrete with a specified compressive strength ($f'c$) greater than 5000 psi (35MPa), required air content may be reduced to $5\% \pm 1.5\%$.
4. Entrained air content noted above shall occur at point of delivery.
5. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.
6. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete

1. Unless lower limits are stated in the Contract Documents, all concrete exposed to freezing and thawing in moist condition (Exposure Classes F1 and F2) and/or required to be watertight shall have a maximum W/cm ratio of 0.45 and a minimum $f'c=4500$ psi.
2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources (Exposure Class F3) shall have a maximum W/cm ratio of 0.40 and a minimum $f'c=4500$ psi.
3. Absent the above conditions, all concrete with required strength of 4000 psi (28MPa) or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the Owner's testing agency responsibilities:
 - a) Concrete with high range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" (75mm) for normalweight concrete and 4" (100mm) for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" (225mm) unless otherwise approved by the SER.
 - b) Concrete without a water-reducing admixture: Slump shall not exceed 4".

F. Self-Consolidating Concrete Slump/Flow: Use for architectural concrete and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of **[20" (500mm)]** or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.

G. Chloride Ion Content

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 4.3 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to the Owner.

2.3 ADMIXTURES

A. General:

1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:

1. ASTM C 260
2. Acceptable Product: BASF "MasterAir AE 200"" or "MasterAir -AE 90"
3. Acceptable Product: W. R. Grace "Darex Series" or "Daravair Series"

4. Acceptable Product: Euclid Chemical Company "AEA -92 or Air 40"
5. Acceptable Product: Sika Corporation "Sika Air Series" or "Sika AEA Series"

C. Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Product: BASF "MasterPozzolith 210"
3. Acceptable Product: Euclid Chemical Company "EUCON NW" or "EUCON WR 91"
4. Acceptable Product: W. R. Grace "WRDA" Series, Zyla Series or "Mira" Series
5. Acceptable Product: Sika Corporation "Plastocrete Series"

D. Retarding Admixture:

1. ASTM C 494, Type B
2. Acceptable Product: BASF "Masterset R 100"
3. Acceptable Product: Euclid Chemical Company "EUCON RETARDER 100"
4. Acceptable Product: W. R. Grace "Daratard 17"
5. Acceptable Product: Sika Corporation "Plastiment Series"

E. Non Corrosive Accelerating Admixture:

1. ASTM C 494, Type C
2. Acceptable Product: BASF "POZZUTEC 20" or "Masterset NC 534"
3. Acceptable Product: Euclid Chemical Company "ACCELGUARD 80", "ACCELGUARD NCA" or "ACCELGUARD 90"
4. Acceptable Product: W. R. Grace "Daraset" Series, "Polarset", or "DCI"
5. Acceptable Product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL" or "Sika Rapid-1"

F. Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type D
2. Acceptable Product: BASF "Masterset R 100"
3. Acceptable Product: Euclid Chemical Company "EUCON RETARDER 75" or "EUCON DS"
4. Acceptable Product: W. R. Grace "Daratard 17" or "Recovery Series"
5. Acceptable Product: Sika Corporation "Plastiment Series"

G. Water-Reducing and Accelerating Admixture:

1. ASTM C 494, Type E
2. Acceptable Product: BASF "Masterset FP 20"
3. Acceptable Product: Euclid Chemical Company "ACCELGUARD 80" or "ACCELGUARD 90"
4. Acceptable Product: W. R. Grace "Libricon NCA"
5. Acceptable Product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL"

H. Mid-Range Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Product: BASF "MasterPolyheed Series"
3. Acceptable Product: W. R. Grace "Daracem" or "Mira"
4. Acceptable Product: Sika Corporation "Sikaplast Series" or "Sikament Series"
5. Acceptable Product: Euclid Chemical Company: "Eucon MR" or "Eucon MRX"

I. Corrosion Inhibiting Admixtures:

1. Calcium Nitrite Based: ASTM C 494, Type C, 30% + 2% solution
 - a) Acceptable Product: W.R. Grace "DCI or DCI-S"
 - b) Acceptable Product: Euclid Chemical Company "EUCON CIA"
 - c) Acceptable Product: Sika Corporation "Sika CNI"
2. Amine Carboxylate Based: ASTM C 1582, which includes ASTM C-494 amine carboxylate
 - a) Acceptable Product: Cortec Corporation "MCI 2005", "MCI 2005 NS", "MCI 2006" or "MCI 2006 NS"
3. Amino Alcohol Based:
 - a) Acceptable Product: Sika Corporation "Sika FerroGard 901"

2.4 ADHESIVES

- A. Bonding Agent for Cured Concrete (existing concrete damp or dry, at least 28 days old, no surface water):
1. ASTM C 881 Type I and IV, Grade 3, Class B and C.
 2. Acceptable Product: BASF "CONCRETSIVE PASTE (LPL)", Class C Only
 3. Acceptable Product: BASF "CONCRETSIVE LIQUID (LPL)", Class C Only for bonding topping
 4. Acceptable Product: Euclid Chemical Company "EUACO #452 Epoxy System"
 5. Acceptable Product: Euclid Chemical Company "DURALCRETE LV Series"
 6. Acceptable Product: Euclid Chemical Company "FLEXOCRETE System" for bonding topping
- B. Bonding Agent for Uncured Concrete: (existing concrete damp or dry, less than 28 days old, no surface water):
1. ASTM C 881, Type II and V, Grade 2, Class B and C.
 2. Acceptable Product: Euclid Chemical Company "DURALCRETE MV System"
 3. Acceptable Product: Sika Corporation "Sikadur 32 Hi-Mod"
- C. Anti-Corrosive Epoxy Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):

This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

1. Acceptable Products: Euclid Chemical Company "DURALPREP AC"
2. Acceptable Products: Sika Corporation "ARMATEC 110"

D. Adhesive Between Cured Concrete Elements:

1. ASTM C 881 Type I and IV, Grade 3, Class B and C
2. Acceptable Product Sika Corporation "Sikadur 31 Hi-Mod Gel (1:1 Mix Ratio)"

2.5 CURING COMPOUNDS AND SEALERS

A. Interaction with finishes:

1. See architectural Drawings for finish material applied over concrete.
2. Use only curing and sealer compounds that are compatible with finish material.
3. Manufacturer's certification is required.
4. Where finish material is liquid rubberized asphalt, use only strippable type curing compound.

B. Curing and Sealing Compound (VOC Compliant, 350 g/l) :

1. ASTM C1315, Type I, Class A and ASTM C 309, Type 1, Class A or B
2. Water based acrylic, clear, 25% solids curing and sealing compound.
3. Acceptable Product: Euclid Chemical Company "Super Diamond Clear VOX"
4. Acceptable Product: Dayton Superior "Cure & Seal J22WB)
5. Acceptable Product: BASF (Sonneborn) "Kure 1315"
6. Acceptable Product: W.R. Meadows "VOCOMP-25"

C. Curing Compound-Dissipating/Strippable (VOC Compliant, 350 g/l):

1. ASTM C 309, Type I, Class A or B
2. Water based resin, clear curing compound that begins to dissipate when exposed to UV light and traffic.
3. Acceptable Product: Euclid Chemical Company "Kurez DR VOX" (Dissipating) or "Kurez RC" in combination with "Kurez RC-Off" (Strippable)
4. Acceptable Product: Dayton Superior "Clear Resin Cure J11W"
5. Acceptable Product: W.R. Meadows: "1100 Clear"

2.6 SEALERS

A. Surface Sealer:

1. ASTM C 309, Type I, Class A or B
2. Water based acrylic sealing compound.
3. Acceptable Product: Euclid Chemical Company "DIAMOND CLEAR VOX"
4. Acceptable Product: Dayton Superior "Cure & Seal 309 EF"

5. Acceptable Product: BASF "MasterKure CC 200WB"
6. Acceptable Product: "W.R. Meadows "VOCOMP 20"

B. Liquid Densifier/Sealer:

1. The liquid densifier compound shall be a silicate based compound that penetrates and chemically hardens concrete surfaces.
2. Acceptable Product: Euclid Chemical Company "Euco Diamond Hard"
3. Acceptable Product: Dayton Superior "Densifier J13"
4. Acceptable Product: BASF "MasterKure HD 200WB"
5. Acceptable Product: W.R. Meadows "Liqui-Hard"

2.7 DRY SHAKE HARDENERS

A. Mineral Aggregate Hardener:

1. The specified mineral aggregate hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specially processed graded mineral aggregate, selected Portland cement and necessary plasticizing agents
2. Acceptable Product: Euclid Chemical Company, "Surflex" to be used with "Kurez DR VOX"
3. Acceptable Product: BASF, "MasterTop 100 to be used with "Masterkure CC 200WB"
4. Acceptable Product: L&M Construction Chemicals "Ferrocon FF" to be used with "Dress & Seal WB 30"

B. Non-Oxidizing Metallic Hardener:

1. The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected Portland Cement and necessary plasticizing agents.
2. Acceptable Product: Euclid Chemical Company, "Diamond-Plate" to be used with "Kurez DR VOX"
3. Acceptable Product: BASF "MasterTop 210COR" to be used with "MasterKure CC 200WB"

2.8 MISCELLANEOUS CONCRETE PRODUCTS

A. Nonshrink Grout

1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:
 - a) See General Notes for grout minimum compressive strength.
 - b) Grout shall conform to ASTM C 1107
2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F (7°C) and 90°F (32°C) limits when testing is initiated.

3. Acceptable Product: BASF "MASTERFLOW 928"
4. Acceptable Product: Euclid Chemical Company "HI-FLOW GROUT"
5. Acceptable Product: Five Star Products "Five Star Grout"
6. Acceptable Product: Sika Corporation "Sikagrout 328"

B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:

1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" (25mm) thickness without aggregate in one pour. If greater than 1" (25mm) thickness is required, aggregate shall be used in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
2. Acceptable Product: Ardex Engineered Cements "ARDEX K-15"
3. Acceptable Product: Euclid Chemical Company "Flo-Top or Super Flo-Top"
4. Acceptable Product: Sika Corporation "Sika Level Series"

2.9 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:

1. Acceptable Product: BASF "Masterkure ER50"
2. Acceptable Product: Euclid Chemical Company "Eucobar"
3. Acceptable Product: Sika Corporation "Sika Film"

B. Sand Cushion: Clean, manufactured or natural sand.

C. Expanded Polystyrene (EPS) used as Fill - Geofoam

1. Material: Rigid, closed cell polystyrene blocks formed by expansion of polystyrene beads by steam.
2. Comply with the requirements of ASTM D 6817
3. Unless noted otherwise on the drawings, provide the following types of EPS:
 - a) Fill between a lower slab and a raised slab area: EPS12 -2.2 psi (15 kPa) compressive resistance minimum at 1% deformation, 10 psi (70 kPa) flexural strength minimum
 - b) Typical below interior floor slabs supported on grade (soil fill over EPS fill) or directly on EPS fill: EPS15 - 3.6 psi (25 kPa) compressive resistance minimum at 1% deformation, 25 psi (170 kPa) flexural strength minimum
 - c) Fill below exterior floor slabs or slabs with truck loading: EPS19 - 5.8 psi (40 kPa) compressive resistance minimum at 1% deformation, 30 psi (200 kPa) flexural strength minimum
4. Thickness as indicated on Drawings.
5. Execution: Conform to manufacturer's instructions regarding preparation, installation and protection
6. Gripper plates shall be used as needed to restrain EPS from moving laterally in multi-layer applications

7. Contractor shall sequence soil or concrete topping placement to avoid EPS block shift or flotation.
 8. Submit the following for review:
 - a) Manufacturer's product literature including physical properties in compliance with ASTM D 6817 and type specified
 - b) 10 year physical property warranty
 9. Submit the following for record:
 - a) Summary of test compliance with specified performance characteristics and physical properties
 - b) Product Certificates showing evidence of third party quality control
 10. Acceptable product: Foam Control EPS Geofoam by AFM Corporation, Lakeville, MN
 11. Acceptable product: EPS Geofoam by Styrotech, Brooklyn Park, MN
 12. Acceptable product: EPS Geofoam by Universal Foam Products, Hunt Valley, MD
 13. Acceptable product: EPS Geofoam by Dyplast Products, Miami, FL
- D. Vapor Retarder: See Division 7, Thermal and Moisture Protection

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade:
1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
 - a) Omit when subgrade is already damp.
 2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
 3. Do not place concrete on frozen ground.
- B. Forms:
1. Coordinate with Section 031000 Concrete Formwork.
 2. Remove dirt, sawdust, nails and other foreign material from formed space.
 3. Dampen wood forms by sprinkling immediately before placing.
 4. Cool metal forms by sprinkling immediately before placing.
- C. Concrete Accessories:
1. Coordinate with Section 031000 Concrete Formwork.
- D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

3.2 JOINTS IN CONCRETE

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

1. Do not use contraction joints in framed floors or composite slabs.
2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.

a) Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.

4. Maximum joint spacing is as indicated on Drawings.

B. Construction Joints:

1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.
2. Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Architect.
3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen to $\frac{1}{4}$ " **[6 mm]** amplitude. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces

C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical

surfaces, such as column pedestals, foundation walls and other locations, as indicated.

- D. Joint Fillers: Coordinate with Section 032000 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

3.3 MIXING

- A. Measurement of Materials: Conforming to ASTM C 94
- B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:
 - 1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
 - 2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Owner's Testing Agency.
 - 3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.
- C. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

3.4 CONCRETE PLACEMENT

- A. Prior to Concrete Placement:
 - 1. Mechanical vibrators are required and must be available for placing concrete.
 - 2. Remove debris from space to be occupied with concrete.
 - 3. Notify Design Professionals and Owner's Testing Agency 48 hours prior to starting concrete placement.
 - 4. Approved mix designs must be maintained on file in Contractor's Field Office.
 - 5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 032000 and Drawings.
 - 6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
 - 7. Do not place concrete having a slump outside of allowable slump range.
 - 8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills. Placement upon soft mud or dry earth is not permitted.
 - 9. Unless adequate protection is provided, concrete shall not be placed during rain.
 - 10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.

11. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
12. Keep subgrade moisture uniform without puddles or dry areas.
13. Place vapor retarder directly below slabs on grade as specified in Contract Documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318, Chapter 6. For variations from these requirements, submit a written request for Design Professionals' review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.
5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

D. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 031000/Concrete Formwork.
2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24" (600mm) and in a manner to avoid inclined construction joints.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
 - a) Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
9. Do not insert vibrators into lower layers of concrete that have begun to set.
10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
11. Do not vibrate Self-Consolidating Concrete (SCC).

E. Placing Concrete Slabs:

1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
 - a) Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.
 2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
 3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 4. Bring slab surfaces to correct level with a straightedge and strike off.
 - a) Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
 - b) Do not disturb slab surfaces prior to beginning finishing operations.
 5. Maintain reinforcing in proper position on chairs during concrete placement.
 6. Do not place materials on slabs or impose loads during period of setting.
- F. Placing Concrete at Construction Joints:
1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
 2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
 3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
 4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.
- G. Cold-Weather Placement:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
 2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
 3. Do not use frozen materials or materials containing ice or snow.

- a) Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.

H. Hot-Weather Placement:

1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below **[90°F (32°C)]**.
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

3.5 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. For slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than **[72]** hours of concrete placement by Owner's Testing Agency.
4. See architectural Drawings for locations of the various finishes listed below.
5. Comply with the specified overall SOF_F and SOF_L values listed below:
 - a) The specified overall area shall be each individual floor.
 - b) F_F/F_L shall be measured in accordance with ASTM E 1155.
 - c) The specified minimum local values of MLF_F/MLF_L shall be 3/5 of the SOF_F/SOF_L values listed below.

- d) If an individual test section measures less than either of the specified minimum local MLF_F / MLF_L numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
 - e) If the composite value of the test surface measures less than either of the specified overall SOF_F / SOF_L numbers, then the entire slab may be rejected and remedial measures may be required.
 - f) F_L numbers shall not apply to unshored slabs or shored slabs with camber.
- B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural Drawings:
 - 1. Scratch Finish.
 - a) Finish surface to overall value of $SOF_F=20$ and $SOF_L=15$.
 - b) Slope surfaces uniformly to drains where required.
 - c) After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural Drawings:
 - 1. Float Finish.
 - a) After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
 - b) Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
 - c) Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
 - d) Finish surfaces to overall value of $SOF_F=20$ and $SOF_L=15$.
 - e) Cut down high spots and fill low spots.
 - f) Uniformly slope surfaces to drains.
 - g) Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural Drawings:
 - 1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
 - 2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
 - 3. Finish surface to overall value of $SOF_F=20$ and $SOF_L=15$.
 - 4. Texture shall be approved by the Design Professionals from sample panels.

- E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile on thick-set mortar, paint or another thin film-finish coating system, as indicated on architectural Drawings:
1. Trowel Finish.
 - a) After floating, begin first trowel-finish operation using a power-driven trowel.
 - b) Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
 - c) The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
 - d) Grind smooth any surface defects that would telegraph through applied floor covering system.
 2. Finish surface to overall value of $SO_{Ff}=25$ and $SO_{Fl}=20$.
 3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
 4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
 5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
 6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
 7. Dry Cement: Shall not be used during finishing.
- F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural Drawings:
1. Trowel and Fine Broom Finish:
 - a) Apply a trowel finish as specified.
 - b) Immediately follow by slightly scarifying the surface with a fine broom.
 2. Finish surface to overall value of $SO_{Ff}=35$ and $SO_{Fl}=25$.
- G. Tolerances at Slab Discontinuities
1. Within 2 ft (600mm) of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the Contract Documents, the following equivalent straightedge tolerances shall apply:
 - a) Specified local $MLF_f = 12$, use 1/4" (6mm) over 4 ft (1200mm), no offset greater than 1/16" (2mm)
 - b) Specified local $MLF_f = 15$, use 1/8" (3mm) over 4 ft (1200mm), no offset greater than 1/32" (0.8mm)
- H. Dry Shake Finish:

1. Non-slip aggregate where indicated on Drawings.
 2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. (7.3 kg/m²) and in other locations so noted on the Drawings.
 3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. (5.8 kg/m²) where noted on the Drawings.
 4. Final finish type, method and tolerance as applicable by location and use.
 5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.
- I. Rough Formed Finish:
1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
 2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4" (6mm) in height rubber down or chipped off.
- J. Smooth Formed Finish:
1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings:
 2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 3. Repair and patch tie holes and defects. Remove fins and other projections completely.
- K. Smooth Rubbed Finish:
1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
 2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural Drawings, which have received smooth form finish treatment not later than one day after form removal.
 3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
 - a) Do not apply cement grout other than that created by the rubbing process.
- L. Grout-Cleaned Finish:
1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.

2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

M. Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50°F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
 - a) Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
 - i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
 - ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
 - iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
 - iv. Maintain continuity of coating and repair damage during curing period.
 - v. Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

- vi. Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent.
- vii. Hand-brooming and sweeping is not sufficient.
- viii. Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.

b) Provide moist curing by the following methods:

- i. Keep concrete surface continuously wet by covering with water.
- ii. Use continuous water-fog spray.
- iii. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4" (100mm) lap over adjacent absorptive covers.

c) Provide moisture-retaining cover curing as follows:

- i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" (75mm) and sealed by waterproof tape or adhesive.

- (1) Immediately repair any holes or tears during curing period using cover material and waterproof tape

- 6. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
- 7. Cure surfaces exposed to deicing salts, brackish water, etc., such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
- 8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).

- a) If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.

B. Cold-Weather Protection:

- 1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:

1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
 - a) Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
 2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.
- D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.7 CONCRETE REPAIRS

- A. Perform patching and repairs in accordance with ACI 301.
- B. Contractor shall submit patching and repair methods and materials for review by Design Professionals.
- C. When complete, all patches and repairs shall match color and texture of adjoining surfaces.
- D. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Design Professionals to verify repair color and texture match before proceeding with repair.
- E. Apply all patching and repair materials in accordance with manufacturer's specifications.
- F. Repairing Cracks In Formed and Unformed Surfaces:
 1. Contractor shall notify Design Professionals of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Repair Materials section of this Specification for acceptable products
- G. Repairing Formed Surfaces
 1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
 2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
 3. Remove stains from rust, grease and oils, from release agents, etc.

4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.
 - a) Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - b) Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.
5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

H. Repairing Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
 - a) Correct high areas by grinding after concrete has cured at least 14 days.
 - b) Correct low areas by applying leveling material. Finish leveling material as specified in this section.
2. Repair surfaces containing defects that affect durability of concrete.
 - a) Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.
 - a) Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

- I. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.8 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. In accordance with ACI 301, except where otherwise specified.

- B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.9 CORRECTIVE MEASURES

- A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.
- B. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

[Balance of page blank; see form on next page]

CONCRETE MIX DESIGN SUBMITTAL FORM

Project:	_____
City:	_____
General Contractor:	_____
Concrete Contractor:	_____
Concrete Strength:	_____
Use/Location on Job:	_____
Supplier's Mix Designation:	_____

Design Mix Information **(Please check one):** *Refer to ACI 301 for requirements of data used to substantiate strength calculations.*

Field Experience (Based on
Standard Deviation
Analysis): _____

Trial Mixture Test Data: _____

Design Characteristics:

Density:	_____	Pcf (kg/m ³)
Strength:	_____	Psi (MPa) (28 day)
Air:	_____	% (specified)

Materials:	Type/Source	Specific Gravity	Weight (lb)	Absolute Vol. (cu. ft.) (cu. m)
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft. (1.0 m ³)
Water/Cementitious Material Ratio (lbs. (kg) water / lbs. (kg) cementitious material) =				%

Admixtures:	Manufacturer	ASTM	Dosage (oz/cwt)
Water Reducer:			
Air Entraining Agent:			
High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches (mm)

Slump after HRWR: _____ Inches (mm)

Standard Deviation Analysis (from experience records):

No. of Test Cylinders

Evaluated: _____

Standard Deviation: _____

Required Average Strength f'_{cr}

Average Strength by Tests

Equation Used (ACI Chapter 5)

(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	Age (days)	Mix #1	Mix #2	Mix #3
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	Average	psi (MPa)	psi (MPa)	psi (MPa)
<i>Required Average Strength f'_{cr}</i>				
<i>Average Strength by Tests</i>				
<i>Equation Used (ACI Chapter 5)</i>				

REQUIRED ATTACHMENTS

**Please
check**

Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Fly Ash (or other Supplementary Cementitious Material) Certification	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatibility certification letters	
Chloride Ion Content Certification	
Alkali Aggregate Reactivity Certification	
Shrinkage Test Reports	

SUBMITTED BY:

Name:	
Address:	
Phone no.:	
Main Plant Location:	
Miles from Project:	
Secondary Plant Location:	
Miles from Project:	
Date:	
Certification by Concrete Supplier:	
Signature:	
Print Name:	
PE License Number and Expiration Date (print or stamp)	

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule¹ (check one): ☐ NONE ☐ See Attached5. Effect on Owner's Cost² attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA6. Effect on Construction Documents³ (design work anticipated): ☐ NONE ☐ See Attached7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT
APPLICABLE8. Effect on Other Trades⁴:9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See

Attachment

Signature⁵:

Date:

Company:

General Contractor Signature⁵:

Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.

2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.

3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.

4. Contractor is responsible for effects on other trades from this substitution;

General Contractor must review and agree effects on other trades are fairly represented in items 4-9.

5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void

6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

END OF SECTION

SECTION 035416

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.
- B. Field Test Results: Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- C. Preconstruction Test Reports: Prior to the installation of the underlayment, provide test results indicating slab moisture vapor emission meets the requirements of the finish flooring manufacturer in accordance with ASTM F 2170.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer and factory trained for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of both underlayment and specified floor covering products certification, in writing, that products are compatible.
- C. Preinstallation Conference: Conduct a preinstallation conference at Project site prior to commencement of work.

1. Review preparations for optimum installation, including requirements for the following:
 - a. Purchases.
 - b. Deliveries.
 - c. Submittals.
 - d. Time schedules.
 - e. Environmental conditions.
 - f. Manufacturer's written recommendations.
 - g. Compatibility of materials.
 - h. Acceptability of substrates.
 - i. Temporary facilities and controls.
 - j. Space and access limitations.
 - k. Installation procedures.
 - l. Coordination with other work.
2. Examine substrates and conditions that will affect installation or performance.
3. Review methods and procedures related to underlayment and floor covering installation, including manufacturer's written instructions.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Review temporary protection requirements for products during and after installation.
6. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
7. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 degrees F.

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of **1/8 inch** and that can be feathered at edges to match adjacent floor elevations. Gypsum based formulations will be prohibited.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX GmbH; K-15 Self-Leveling Underlayment Concrete.
 - b. BASF Master Builders; MasterTop 111 SL.
 - c. Drytek Division, Laticrete International; Levelex Plus.
 - d. L&M Construction Chemicals, Inc.; Levelex.
 - e. MAPEI Corporation; Ultraplan 1 Plus.
 - f. Maxxon Corporation; Level-Right Plus.
 2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 3. Compressive Strength: Not less than **4100 psi** at 28 days when tested according to ASTM C 109.
- B. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch**; or coarse sand as recommended by underlayment manufacturer.
1. Provide aggregate for underlayment applications greater than 2-inch thickness and where specifically recommended, in writing, by underlayment manufacturer for project conditions indicated.
- C. Water: Potable and at a temperature of not more than **70 degrees F**.
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Accessory Products: Provide type recommended or required by underlayment manufacturer for project conditions including, but not limited to, the following:
1. Additives.
 2. Reinforcement.
 3. Surface sealers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, chalking, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond. Vacuum all dust and debris.
 - 1. Moisture Testing: Perform tests recommended by flooring manufacturer, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
 - 2. Alkalinity Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum adhesion to substrate and cohesion between coats.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate. Do not leave any bare spots including edges.
- C. Apply underlayment at minimal thickness necessary to level floor to specified levelness and flatness, except as otherwise indicated.

- D. Apply underlayment to produce uniform, level surface. Check product consistency regularly to ensure uniform distribution of product ingredients throughout total thickness of underlayment materials. Avoid overwatering.
 - 1. Apply a final layer without aggregate if required to produce a smooth hard surface.
 - 2. Feather edges to match adjacent floor elevations.
- E. Tolerances: Apply underlayment to the following tolerances, when measured in accordance with ASTM E 1155:
 - 1. Concrete slabs on grade:
 - a. Specified Overall Values (SOV):
 - 1) Flatness: F_F 35.
 - 2) Levelness: F_L 25.
 - b. Minimum Local Values (MLV):
 - 1) Flatness: F_F 24.
 - 2) Levelness: F_L 17.
- F. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- G. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer. Perform dryness tests recommended by manufacturer prior to subsequent installation of floor coverings.
- H. If required by manufacturer, apply surface sealer at rate recommended by manufacturer.
- I. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 FIELD QUALITY CONTROL

- A. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.5 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 040140
STONE MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes stone masonry replacement and repair.

1.3 DEFINITIONS

- A. Stone Terminology: ASTM C 119.

1.4 ACTION SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, mortar mix, and manufactured products.
- B. Samples for Verification:
 - 1. Stone Samples: Sets shall consist of at least three Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.
 - 2. Pigmented mortar. Submit cured Samples using same sand and mortar ingredients to be used on Project.
 - 3. Accessories: Each type of stone anchor and accessory.

1.5 INFORMATIONAL SUBMITTALS

- A. Mix Designs: Include description of mortar type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing stone masonry similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance, and who employs experienced stone masons and stone fitters.
- B. Source Limitations for Stone: Obtain each variety of stone, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. Quality Standard: Stone masonry construction shall comply with applicable requirements of the following:
 - 1. ACI 530/ASCE 5/TMS 402: *Building Code Requirements for Masonry Structures*.
 - 2. ACI 530.1/ASCE 6/TMS 602: *Masonry Structures*.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stone units to Project site strapped together in suitable packs or pallets or in heavy-duty crates.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit stone masonry replacement and repair to be performed according to manufacturers' written instructions and specified requirements.
 - 1. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.
- B. Protection of Stone Masonry: Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

- C. Stain Prevention: Immediately remove mortar and soil to prevent staining stone masonry face.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed stone masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 degrees F** and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.9 COORDINATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, anchors, flashing, and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

- A. Stone: Provide natural building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone.

2.2 MORTAR MATERIALS

- A. Colored Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated.
 - 2. Provide natural color or white cement as required to produce mortar colors indicated.
 - 3. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979.

- a. Use only pigments with a record of satisfactory performance in masonry mortar.
 - b. Pigments shall not exceed 10 percent of portland cement by weight.
4. Products: Subject to compliance with requirements, provide one of the following:
 - a. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - b. Lafarge North America Inc.; Eaglebond Portland & Lime.
 - c. Lehigh Hanson; HeidelbergCement Group; Lehigh Custom Color Portland/Lime Cement.
- B. Aggregate for Mortar: ASTM C 144.
 1. Colored-Mortar Aggregates: Washed aggregate consisting of natural sand of color necessary to produce required mortar color.
 2. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
- C. Aggregate for Grout: ASTM C 404.
- D. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
- E. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

- A. Stone Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cathedral Stone Products, Inc.; Jahn Restoration Mortars.
 - b. Conproco Corporation; Mimic or Matrix.
 - c. Edison Coatings, Inc.; Custom System 45.
 2. Use formulation that is vapor- and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all types of stone.
 3. Formulate patching compound in colors, textures, and grain to match stone being patched. Provide sufficient number of colors to enable matching each piece of stone.

- B. Cementitious Crack Filler: An ultrafine super-plasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cathedral Stone Products, Inc.; Jahn Injection Grout.
 - b. Conproco Corporation; Terra Cotta Finish.
 - c. Edison Coatings, Inc.; Pump-X 53-Series.

2.4 CLEANING MATERIALS

- A. Job-Mixed Detergent Solution: Solution prepared by mixing **2 cups** of tetrasodium polyphosphate, **1/2 cup** of laundry detergent, and **20 quarts** of hot water for every **5 gal.** of solution required.
- B. Job-Mixed Mold, Mildew, and Algae Remover: Solution prepared by mixing **2 cups** of tetrasodium polyphosphate, **5 quarts** of 5 percent sodium hypochlorite (bleach), and **15 quarts** of hot water for every **5 gal.** of solution required.
- C. Water: Potable.

2.5 ACCESSORY MATERIALS

- A. Stone Anchors and Pins: Fabricate from stainless steel, ASTM A 666, Type 304 or Type 316; type and size required for application.
- B. Setting Buttons: Resilient plastic buttons, nonstaining to stone.

2.6 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement and lime.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Portland Cement-Lime Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - 1. Mix to match Architect's control sample.
 - 2. Use preblended, pigmented, Portland cement-lime mortar mix for all mortar applications.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For exterior, above-grade, load-bearing and non-load-bearing walls, and for other applications where another type is not indicated, use Type N.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where stone masonry will be replaced or repaired, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPERATION

- A. Protect persons, motor vehicles, site, plants, and surrounding surfaces of building where stone masonry will be replaced or repaired from harm resulting from performance of work.
- B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- C. Prevent mortar from staining face of surrounding stone and other surfaces.
 - 1. Cover sills, ledges, and projections to protect from mortar droppings.
 - 2. Immediately remove mortar in contact with exposed stone and other surfaces.
 - 3. Clean mortar splatters as the work progresses.

3.3 UNUSED ANCHOR REMOVAL

- A. Remove stone anchors, brackets, and other extraneous items no longer in use as the work progresses.
 - 1. Remove items carefully to avoid spalling or cracking stone.

3.4 STONE REMOVAL AND REPLACEMENT

- A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair. Carefully demolish or remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units.

- B. Support and protect remaining stonework that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone masonry, rotted wood, rusted metal, and other deteriorated items.
- D. Remove in an undamaged condition as many whole stone units as possible.
 - 1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
 - 2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.
 - 3. Store stone for reuse, wherever possible. Store off ground, on skids, and protected from weather.
- E. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.
- F. Replace removed damaged stone with other removed stone in good quality, where possible, or with new stone matching existing stone, including size. Do not use broken units unless they can be cut to usable size.
- G. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.
- H. Set replacement stone with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type indicated.
- I. Tool exposed mortar in repaired areas to match mortar setting of surrounding existing stone masonry.

3.5 PARTIAL STONE REPLACEMENT

- A. Remove defective portion of existing stone masonry full depth.
 - 1. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
 - 2. If existing stone that is to remain becomes damaged, remove damaged area and enlarge partial replacement as required.
- B. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.
- C. Concealed Pinning: Mechanically anchor stone masonry with threaded stainless-steel pins set into supporting construction but not through the partial replacement.

3.6 CRACK INJECTION

- A. General: Comply with cementitious crack-filler manufacturer's written instructions.
- B. Drill **1/4-inch** diameter injection holes as follows:
 - 1. Transverse Cracks Less Than **3/8 inch** Wide: Drill holes through center of crack at **12 to 18 inches** on center.
 - 2. Transverse Cracks More Than **3/8 inch** Wide: Drill holes through center of crack at **18 to 36 inches** on center.
 - 3. Drill holes **2 inches** deep.
- C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.
- D. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.
- E. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.
- F. Clean cementitious crack filler from face of stone before it sets by scrubbing with water.
- G. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.

3.7 STONE PATCHING

- A. Patch the following stone units unless another type of replacement or repair is indicated:
 - 1. Units indicated to be patched.
 - 2. Units with holes.
 - 3. Units with chipped edges or corners.
 - 4. Units with small areas of deep deterioration.
- B. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch will not have feathered edges but will have square or slightly undercut edges on area to be patched and will be at least **1/4 inch** thick, but not less than recommended by patching compound manufacturer.
- C. Mask adjacent mortar if patch will extend to edge of stone unit.
- D. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

- E. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.
- F. Place patching compound in layers as recommended by patching compound manufacturer, but not less than **1/4 inch** or more than **2 inches** thick. Roughen surface of each layer to provide a key for next layer.
 - 1. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing to best match existing stone.
 - 2. Convex Stone Surfaces: Build patch up **1/4 inch** above surrounding stone and carve surface to match adjoining stone after patching compound has hardened.
- G. Keep each layer damp for 72 hours or until patching compound has set.
- H. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.8 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water.
 - 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.
 - 3. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.

3.9 EXCESS MATERIALS AND WASTE

- A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than **4 inches** in greatest dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
 - a. Refer to Site Drawings for requirements for acceptable fill materials.
 - 3. Do not dispose of masonry waste as fill within **18 inches** of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 04 01 40

SECTION 051200
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete	Section 033000
Steel Joists	Section 052000
Steel Deck	Section 053000
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.
2. **ANSI/AISC 341 and 341s1- Seismic Provisions for Structural Steel Buildings, Including Supplement No. 1; American Institute of Steel Construction, Inc.**
3. American Institute of Steel Construction (AISC 303), "Code of Standard Practice", shall apply except:
 - a) In item 3.1.2 delete all references to item 4.4 and replace with the requirements of the project Specification.
 - b) Item 3.6 shall be deleted.
 - c) Item 4.4 shall be deleted, and replaced with the requirements of the project Specification.

- d) The second paragraph of item 7.10.3 shall be revised from "... owner's designated representatives for design and construction" to "owner's designated representative for construction or as indicated in the Contract Documents"
- e) The last sentence of items 8.5.2 and 8.5.4 shall be deleted.
- f) Item 8.5.3 shall be deleted. Where a conflict exists between the Code of Standard Practice and the Contract Documents, the Contract Documents shall govern.

- 4. American Welding Society, AWS D1.1, "Structural Welding Code".
- 5. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- 6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
- 7. The Society for Protective Coatings (formerly Steel Structures Painting Council, "SSPC") "Steel Structures Painting Manual".

C. Definitions:

- 1. The term "Contract Documents" in this Specification is defined as the design Drawings and the Specifications.
- 2. The term "SER" in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
- 3. The term "Design Professionals" in this Specification is defined as the Owner's Architect and SER.
- 4. The term "Contractor" in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Structural Steel Fabricator or Structural Steel Erector.
- 5. The term "Heavy Shapes" in this Specification is defined to include hot rolled steel shapes with flanges exceeding 2 inches (50mm) in thickness and built up cross sections with plates exceeding 2 inches (50mm) in total thickness.
- 6. The term "High Restraint Weld" describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.
- 7. The term "Testing Agency" in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of steel construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
- 8. The terms "for record" and "submit for record" in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
- 9. Working Days: Monday through Friday, except for federal or state holidays.

1.5 CONTRACTOR QUALIFICATIONS

- A. The term Structural Steel Contractor refers to any or all of the following parties, regardless of their contractual relationships: Structural Steel Fabricator, Structural Steel Detailer, Structural Steel Erector and Contractor's Engineer.

- B. Qualification Data: Submit qualification data (personnel and firm resumes, and project lists with references) for the Structural Steel Fabricator ("Fabricator"), Structural Steel Detailer ("Detailer"), Contractor's Engineer(s) and Structural Steel Erector ("Erector").
- C. The Fabricator shall have 10 years of comparable experience in installations of this type and shall employ labor and supervisory personnel familiar with the type of installation, experienced in fabrication and erection of structural steel for projects of similar size and complexity. At the time of bid the Fabricator shall be AISC certified to the Standard for Steel Building Structures (STD) and must submit proof of these qualifications. The Fabricator's qualifications shall be subject to review by the Design Professionals and Owner.
- D. The Detailer shall have 10 years experience preparing detailed steel shop drawings and CNC downloads for structures of this type and complexity. The detailer's qualifications shall be subject to review by the Design Professionals and Owner.
- E. The Contractor's Engineer(s) shall be qualified to perform the type of work required by the project. The Engineer(s) shall be a Licensed **Professional Engineer(s) in State of NJ**. The Contractor's Engineer(s) shall have 10 years of experience being in responsible charge of work of this nature. The proposed Engineer(s) shall be subject to approval of Design Professionals and Owner.
- F. The Erector shall have 10 years of successful experience erecting structural steel for structures of this type and complexity in the region of the project. At the time of bid the Erector shall be an AISC Certified Steel Erector (CSE) and must submit documentation of this qualification. **At the time of bid the Erector shall be an AISC Advanced Certified Steel Erector (ACSE) and must submit documentation of this qualification.**
- G. Welding: Qualify the welding procedures, shop welders, field welders, welding operators and tackers in accordance with AWS D1.1 and for the following periods of effectiveness of certification:
 - 1. Certification and qualification, including period of effectiveness of welding personnel shall be as specified by AWS D1.1. Certification shall remain in effect for duration of work provided welders are continuously engaged in performing the type of welding for which they are certified, unless welders fail to perform acceptable welding, as determined by the Owner's Testing Agency. Certification and re-certification of welding personnel is subject to verification by the Testing Agency. Re-testing for re-certification will be the Contractor's responsibility.

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted.

(1) Submittal Schedule

- (2) Calculations, Shop Drawings and Erection Drawings
- (3) Submittal Letters
- (4) Pre-construction Survey
- (5) **Erection Procedure**
- (6) Quality Control Program
- (7) Product Data
- (8) Samples
- (9) Welding Procedures Specification (WPS)
- (10) Welder Certifications
- (11) Mill Reports
- (12) As-built surveys
- (13) LEED Submittals

1. **Submittal Schedule:** The contractor shall submit for approval a typical connection design calculation and shop drawing submission schedule at least twenty (20) working days prior to commencing submission of connection design calculations and shop drawings.
 - a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, including but not limited to the number of calculation sheets, erection drawings, and piece drawings, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for approval at least twenty (20) working days before the modification or addition is proposed to take place.
 - b) If at any time the total number of connection design calculations, erection drawings and shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
 - c) For the purposes of developing a schedule, assume the following review rates:
 - Calculations – 100 – 8 ½' x 11" sheets per week
 - Shop drawings – 300 pieces per week
2. **Calculations, Shop Drawings and Erection Drawings** (including Field Work drawings): Submit for approval required connection calculations, shop drawings and erection drawings for all structural steel indicated on the Contract Documents.
 - a) Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.

- b) Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as "Completely Designed." Each calculation package shall be signed and sealed by the Contractor's Engineer.
 - c) Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.
 - d) Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.
 - e) Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the SER. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.
 - f) Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.
 - g) Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items. All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size, type, number, location and any special installation requirements, and field weld size, type, length and location.
3. **Submittal Letters:** The Contractor shall submit for record letters from the Contractor's Engineer supervising the preparation of connection designs on shop and erection drawings.
- a) A letter shall be submitted along with the first submission of Connection design calculations. It shall be signed and sealed by the Contractor's Engineer, and shall include the following:

"All Connection design calculations for this project have been developed, and all details and connections for this project will be designed, by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."

- b) **A second letter** shall be submitted upon the satisfactory submission, review and/or approval of **all** shop and erection drawings. It shall be signed and sealed by the Contractor's Engineer and include the following:

"All details and connections as shown on the **[final] [listed]** shop and erection drawings for this project have been designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."

4. **Preconstruction Survey:** Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals. For all steel construction, before steel erection commences, perform and submit to the Design Professionals a complete survey for position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines, and elevations of bearing surfaces and tops of bolts relative to building Datum elevation.
5. **Erection Procedure: Submit a steel erection procedure, prepared under the supervision of the Contractor's Engineer, for review by the SER. The review by SER shall only be for the effects of the steel erection procedures on the final structure. This erection procedure shall, as a minimum, meet requirements outlined on the Contract Documents and shall bear the seal and signature of the Contractor's Engineer. No deviation from the approved procedure will be permitted without prior written approval by the Contractor's Engineer and review by the SER.**
6. **Quality Control Program:** Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.
7. **Product Data:** Submit manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.
8. **Samples:** Submit (2) samples each, (2) of shop painted products and (2) of field touch-up painted products. Samples shall be steel material.
9. **Welding Procedures:** Submit for record written welding procedures for all AWS D1.1 prequalified joints, and qualification procedures for all joints not prequalified by Section 3 of AWS D1.1. Submit written welding procedures developed by Contractor's welding consultant for heavy shapes and High Restraint Welds described in this Specification. Use the forms in AWS D1.1, Annex E. Submit all welding and qualification procedures to the Owner's Testing Agency for approval before submitting to the Design Professionals.
10. **Welder Certification:** Submit for record certification that the welders have passed qualification tests **acceptable to the governing authority** using AWS procedures.

- a) A certification shall be submitted in standard AWS format.

- b) Each certification shall state that the welder has been doing satisfactory welding of the required type within the six-month period prior to the subject work.

For any welder whose period of certification effectiveness has lapsed or whose workmanship is subject to question in the opinion of the Design Professionals or Testing Agency, immediate testing for recertification will be required. Tests, when required, shall be conducted at the sole expense of the Contractor.

- 11. **Mill Reports:** Submit for record certified copies of all mill reports, two (2) to the Design Professionals and one (1) to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this Specification) for the project.

- a) Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.
- b) Prior to commencing steel erection, the contractor shall deliver certificates to the Owner in number and form as may be required by the local Building Department or other local and State agencies having jurisdiction.

- 12. **As-Built Surveys:** Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each certified survey, performed by a professional surveyor employed by the Contractor, shall be submitted to the Contractor's Engineer for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, the Contractor shall present corrective measures to the Design Professionals within 48 hours of completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Design Professionals and the Owner.

B. Submittal Process

- 1. Submittal of shop and erection drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
- 2. Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as "Completely Designed." The

Contractor shall submit connection design calculations and receive an action of approval prior to submitting shop drawings related to those calculations. The shop drawings shall incorporate all comments provided on the calculations.

3. Shop and erection drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop and erection drawings shall be referenced on each shop and erection drawing to facilitate checking. Unless the piece marks are self-indexing, furnish index sheets with the shop drawings, relating piece marks for all beam, girder and column details to the sheet numbers on which they are located.
4. The Contractor shall submit to the Design Professionals **two (2) black line prints and one (1) electronic copy** for shop drawing review. If the Contractor and Design Team agree to process shop drawings electronically, Contractor shall submit one hardcopy and one electronic copy to the SER. The naming convention of each drawing must follow the submittal numbering system and include the submittal #, specification #, revision # and drawing # in the prefix of the drawing name.
5. The Contractor shall allow at least **ten (10)** working days between receipt and release by the SER for the review of shop and erection drawings and submittals other than connection design calculations. The Contractor shall allow at least **fifteen (15)** working days between receipt and release by the SER for the review of connection design calculations.
6. All modifications or revisions to submittals, shop drawings, connection design calculations and erection drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
 - a) Failure to specifically cloud modifications
 - b) Failure to submit calculations for the modifications
 - c) Unapproved revisions to previous submittals
 - d) Unapproved departure from Contract Documents
7. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) electronic versions of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.
8. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal.
9. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to contractors' errors. The Contractor shall compensate the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%.

C. SER Submittal Review

1. The review of connection design and the review and approval of shop and erection drawings and other submittals by the Design Professionals shall be for general conformance with the design intent of the work and

with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

- a) Responsibility for the adequacy of the design of the connections designed by the Contractor's Engineer.
- b) Responsibility for all required detailing.
- c) Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.
- d) The necessity of furnishing material and workmanship required by contract Drawings and Specifications which may not be indicated on the shop and erection drawings.
- e) Conforming to the Contract Documents.
- f) Coordination with other trades.
- g) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 Stamp - For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require the following actions:

- a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
- b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
- c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
- d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

3. TYPE 2 Stamp - For submittals for building elements which are not designed by the SER but are performance specified, for items that do not form part of the completed structural system but impose loads on the structure, and for construction items or activities which have an effect on the final

structure, a second stamp will be used. The responses on the stamp used by the SER require the following actions:

- a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
- b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
- c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

- 1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
- 2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
- 3. Such substitutions or modifications, if acceptable to the Design Professionals shall be coordinated and incorporated in the work at the sole expense of the Contractor.
- 4. The acceptance by the Design Professionals of a specific and isolated request by the contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
- 5. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)

1. RFI shall originate with the Contractor. RFI submitted by entities other than that Contractor will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.
 - a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:
 - i. No cost clarification
 - ii. Shown in Contract Documents
 - iii. Change to be issued in future bulletin
 - iv. Previously answered
 - v. Information needs to be provided by others.
 - vi. Request for corrective field work
 - vii. Request for substitution
 - b) RFIs in categories 1, 2, 3, 4 and 5 will be turned around by the SER on average of **five (5)** working days.
 - c) RFIs in categories 6 and 7 will be rejected and must be submitted as submittals or requests for substitution.

1.7 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor's Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by the Owner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.
- B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.

- C. Store fasteners in a protected place.
- D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1.

1.9 CONNECTION DESIGN AND DETAILING CONFERENCE

- A. At least 20 working days prior to starting connection design and detailing, the Fabricator shall hold a meeting to verify all connection design assumptions and procedures and shop drawing preparation and submittal procedures.
- B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the connection design and detailing to attend this meeting, including but not limited to:
 - 1. General Contractor
 - 2. Fabricator
 - 3. Detailer
 - 4. Connection Engineer
 - 5. Design Professionals
 - 6. Erector
- C. The Fabricator shall prepare an agenda prior to the meeting, and shall distribute meeting minutes to all parties within 5 working days of the meeting.

1.10 DESIGN OF CONNECTIONS

- A. The contractor is responsible to design all connections not completely designed on the Contract Documents. A Completely Designed connection is only one that is specifically designated as such by the statement "COMPLETELY DESIGNED" on the Contract Documents. All connections not indicated as "COMPLETELY DESIGNED" shall be designed for the forces and/or connection design criteria called for in the Contract Documents.
- B. Connection concepts shown on the Drawings that are not "COMPLETELY DESIGNED" show only the minimum requirements to convey design intent.
- C. All connections and details shown on shop and erection drawings shall be prepared under the supervision of the Contractor's Engineer, in accordance with AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings."
- D. The contractor shall design and provide any stiffener plates, doubler plates, reinforcing plates, etc. and their connections that may be required to develop and/or transfer the forces and/or connection design criteria called for in the Contract Documents.
- E. Design connections to withstand the combined effects of shears, axial forces, moments and torques and as required by applicable code(s) and the Contract Documents.

- F. All forces shown on the Drawings are to be assumed reversible unless noted otherwise and must be checked for both directions. If no transfer/pass-through forces are shown on the Contract Documents, the most critical combinations of member forces and directions shall be assumed for the connection design.
- G. Use types of shop and field connections shown on Contract Documents or, in absence of such indication, propose appropriate type for Design Professionals review.
- H. Welding of High Restraint Welds: Use double bevels in lieu of single bevels where practical. Detail joints to allow for weld shrinkage. In cases of plates in more than one plane, show welding operation sequence on the drawings. In general, start welding at the most restrained part of the weldment and proceed to the least restrained.
- I. All welded connection must utilize pre-qualified joints or joints that have been qualified by AWS D1.1, section 2.
- J. Comply with all connection notes on Drawings in conjunction with these Specifications.
- K. The connection design calculation submittals shall meet the following criteria:
 - a) Number each calculation in a logical and orderly system. Once submitted for review, calculations shall not be renumbered. Resubmitted calculations shall be indicated by using the same number with an "R" suffix. All changes must be clouded.
 - b) Provide sketches for results of each calculation, with all pertinent dimensions relating to the calculations (including pitch, gage, edge distance, unbraced lengths, Whitmore lengths, etc.) clearly shown. Geometry must be shown accurately and to scale. Provide enough sketches to clearly document the full range of geometric conditions applicable to each connection design calculation proposed.
 - c) For repetitive connections provide a spreadsheet or computer program summary table for each specific location, and a standard calculation which shows how the spreadsheet or program calculation applies.
 - d) Provide drawings showing the overall locations of the connections that are keyed/referenced to each connection calculation.
 - e) Calculations shall be typed, or performed by spreadsheet, or by computer program, or by other method approved by the SER. All spreadsheet calculations shall show the input and results for every calculation step and include appropriate text and sketches explaining all calculation assumptions.
 - f) Provide calculation checks for all forces shown on the Drawings. All AISC code requirements apply. Provide calculations for each check. "OK by inspection" is not permitted.

1.11 STRUCTURAL STEEL PRE-ERECTION CONFERENCE:

- A. At least twenty (20) working days prior to the commencing of steel erection the Contractor shall hold a meeting to review the detailed requirements of the steel erection.
- B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:
 - 1. General Contractor/Construction Manager
 - 2. Steel Erector / Steel Fabricator
 - 3. Erector's Surveyor
 - 4. Roof Deck Contractor
 - 5. All Testing and Inspection Agencies
 - 6. Design Professionals
 - 7. Owner
 - 8. Precast or Cladding Contractor as appropriate.
- C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.
- D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.
- E. Notwithstanding any provision of the Specification, the SER shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

1.12 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

- A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program (see the following section on quality control).
- B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.
- C. The Owner has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to the Owner.
- D. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the testing agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owners testing agencies in the performance of their work and shall provide the following:

1. Information as to time and place of starting shop fabrication and a field construction and erection schedule, one week prior to the beginning of the work.
2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office and the drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
3. Representative sample pieces requested by the inspection agency for testing, if necessary.
4. Full and ample means of assistance for testing and inspection of material.
5. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.

E. Duties of the Owner's Testing Agencies:

1. Reports: The Testing Agency shall prepare daily reports of the structural steel work including progress and description/area of work, tests made and results. Reports of inspection of welding shall include deficiencies noted and corrections made, and other items pertinent to acceptance or rejection of the work. The reports shall state whether specimens comply with or deviate from contract requirements. The daily reports shall be collected and delivered to the Design Professionals and Owner weekly.
2. Rejection: The Owner's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall report deficiencies to Owner, Design Professionals, and Contractor immediately.
3. Structural steel work and general testing requirements: The Testing Agency shall perform the following shop and field inspections in addition to any other inspections enumerated above or specified on the Contract Documents:
 - a) Shop inspection of steel shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of heavy shapes as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of heavy shapes, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the SER to 100% at no expense to the Owner.
 - b) Field inspection of steel shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed

- welds, headed studs and deformed bar anchors and field painting, including touch-up.
 - c) Check qualifications of the following:
 - i. Shop welding procedures and personnel
 - ii. Shop stud welding setup and operators
 - iii. Shop bolting procedure and crew
 - d) Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
 - e) Review mill certifications for compliance with the Contract Documents.
4. High Strength Bolting: The Testing Agency inspector shall inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:
- a) Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
 - b) Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
 - c) Visually inspect all bolted connections.
 - d) For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
 - e) For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.
 - f) For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
 - i. "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.
 - g) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.
5. Welding:
- a) Review of submittals: Welding procedures including prequalification, qualifications test and, for heavy shapes and high restraint welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant.
 - b) Full penetration welds: Test all full penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired by the Contractor at the Contractor's expense.

- c) Partial penetration welds: Test all partial penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired by the Contractor at the Contractor's expense.
- d) Testing of welds at heavy shapes and high restraint welds shall be performed not less than 48 hours after the weld has been completed.
- e) Fillet welds: Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each location with 6 or more welds per connection. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.
- f) Inspection and Testing by the Testing Agency of high restraint welds and where Heavy Shapes are to be joined by partial or full penetration welds in tension:
 - i. Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.
 - ii. Test Full Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.
 - iii. Test Partial Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex K-7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.
- g) At heavy shapes and high restraint welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.

6. Headed Studs and Deformed Bar Anchors: Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
 - a) Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition for each member with any defective studs, test an additional member.
 - b) Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.
7. Cleaning & Painting:
 - a) Prior to shop painting, examine all fabricated pieces to verify proper cleaning in accordance with this Specification.
 - b) Examine all shop painting to verify conformance with this Specification.
 - c) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.
8. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Owner on a weekly basis.
9. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and Specification requirements (including applicable codes).

1.13 QUALITY CONTROL BY CONTRACTOR

- A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.
- B. The Owner's general review during construction and activities of the Owner's Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
- C. The Contractor shall immediately report to the Design Professionals any deficiencies in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

1.14 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

- A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
- B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this specification.

1.15 PERMITS AND WARRANTY

- A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.
- B. Warranty: Upon completion of all work to be performed under this Contract, the Contractor shall execute and deliver in a satisfactory form a warranty that all workmanship and materials used in the performance of this Contract shall remain free from defects for a period of one (1) year from the date of execution of the Warranty.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural steel shall conform to the requirements listed on the Structural General Notes.

2.2 SHOP COATINGS

- A. Standard Primer: Rust inhibitive, universal phenolic alkyd metal primer 2-4mls. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient ≥ 0.50 min) requirements. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than **[2.3]** oz per square foot (**[0.70]** kg/ m²), with no individual thickness less than **[2.0]** oz per square foot (**[0.61]** kg/m²).
- D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other coating complying with SSPC-Paint 20.

2.3 ACCESSORIES

- A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specifications for Structural Joints using ASTM A325 or A490 Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.
- B. All bolts shall be new, and not re-used.
- C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM F2329 and ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.
- D. Direct Tension Indicators: Meet requirements of ASTM F959.
- E. Anchor Rods: Per structural General Notes.
- F. Washers:
 - 1. Round washers shall conform to American Standard B 27.2 type b
 - 2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.
 - 3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.
 - 4. The diameter of the hole of square beveled washers shall be 1/16 inch (1.5mm) greater than the bolt size for bolts smaller than one inch (25mm), and shall be 1/8 inch (3.0mm) greater than the bolt size for bolts larger than one inch (25mm).
 - 5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.
- G. Welding Electrodes: Electrodes shall be low hydrogen and shall be selected from Table 3.1 of AWS D1.1.
 - 1. Shielded Metal-Arc Welding: Welding electrodes for manual shielded metal-arc welding shall conform to the specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1 E70 or 80, or the specification for Low-Alloy Steel Covered Arc-Welding Electrode, AWS A5.5.
 - 2. Submerged-Arc Welding: Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Mild Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.
- H. Headed Studs (shear connectors) shall be per Structural General Notes.
- I. Deformed Bar Anchors shall be as specified in Structural General Notes.
- J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.
- K. Grout: Refer to General Notes.

- L. Post-installed Anchors shall be per Structural General Notes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Work by Others: Examine all work prepared by others to receive work of this Section and report any defects affecting installation to Design Professionals. Commencement of work will be construed as complete acceptance of preparatory work by others. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other trades.
- B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, the Contractor shall ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete by others. The Contractor shall immediately bring to the attention of the Design Professionals any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

3.2 FABRICATION

- A. Fabricate and assemble structural steel in the shop to the greatest extent possible.
- B. Tolerances:
 - 1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.
 - 2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.
- C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other trades. All holes shall be accurately drilled or punched at right angles to the surface of the metal in accordance with AISC Specifications. Holes shall not be made or enlarged by burning. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.
- D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.
- E. Cutting: Manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch (12mm) from the finished

dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth.

- F. Cutting of Heavy Shapes: Where "Heavy Shapes" as defined in this Specification are to be joined by partial or full penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F (65°C). Weld access holes and copes shall be ground to a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.
- G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.
- H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.
- I. Bolts indicated as "finger tight" on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.
- J. Installation of High Strength Bolts:
 - 1. Except where "snug tight" installation is specifically permitted on design Drawings, all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts". Calibrated Wrench Pretensioning shall only be used where specifically approved by the SER.
 - 2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
 - 3. All high strength bolt assemblies (including Tension Control bolts and DTI's) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.
 - 4. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.
- K. Welding of Structural Steel:
 - 1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.
 - 2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted

covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.

3. Each welder's work shall be traceable.
 4. Special Requirements: For high restraint welds and welds at heavy shapes, follow approved welding procedures for weld process, sequence, pre-heating and cooling. Use stress relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.
 - a) Special Procedures: Prior to the start of production welding, the contractor shall demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, the contractor shall provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
 - b) Preheat and Postheat: Preheat shall be sufficient to prevent cracking, but in no case less than required by AWS D1.1. For high-restraint welds, minimum preheat shall be 225 degrees F (105°C). The preheat shall be maintained throughout the thickness of the material for a distance equal to twice the material thickness on both sides of the joint at a minimum. Where different thicknesses of steel are being joined, the greater thickness shall govern. Preheat shall be measured on the face opposite the side of the heat application. Preheat shall be applied uniformly in a manner that does not harm the surface of the material nor cause surface temperatures to exceed 1100 degrees F (600°C). Should stress relief heat treatment be required, the contractor shall submit a written procedure.
 5. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.
- L. Bearing:
1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column.
 2. Finish bearing areas of base plates per AISC M2.8.
- M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.
- N. Cleaning and Preparation of Steel Surfaces:
1. Clean all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.

- a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.
- b) Interior, Exposed in the Finished Building: SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
- c) Exterior (exposed to weather or in unconditioned space): SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
- d) Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.

O. Shop Coating:

1. Where painting is specified, paint all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure and in accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.
 - a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.
 - b) Interior, Exposed in the Finished Building: SSPC – Paint 25
 - c) Exterior (exposed to weather or in unconditioned space): SSPC – Paint 20
2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.
3. Do not paint:
 - a) Surfaces within six (6) inches (150mm) of field welds
 - b) Surfaces to be encased in concrete or to receive cementitious fireproofing
 - c) Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the SER)
 - d) Surfaces required for testing and preheat, until all testing and preheat has been performed
 - e) Finished bearing surfaces (use removable rust-inhibiting coating)
 - f) Top flange of the beam where steel deck or headed studs are to be attached
4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.
5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.
6. Hot-dip galvanize the following steel members:
 - a) All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles

- b) All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware
- c) Any other steel members indicated as "Galvanized" on the Contract Documents.
- d) All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

3.3 ERECTION

- A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.
- B. Bracing: Brace the frame during erection in accordance with the Contractor's erection procedure.
- C. Errors: Immediately report to the Design Professionals any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.
- D. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted.
- E. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.
- F. Bolting and Welding of Structural Steel: See Section on "Fabrication".
- G. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.
- H. Splices: Splices will be permitted only where indicated on the Contract Drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.
- I. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the SER.

- J. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.
- K. Hammering: Hammering which may damage or distort the members will not be permitted.
- L. Do not use cutting torches in the field without the specific approval of the SER for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.
- M. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.
- N. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.
- O. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and unpainted areas adjacent to field welds according to manufacturer's recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.
- P. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.
- Q. Clean all steel members of mud and debris and construction residue prior to erection.
- R. Headed Studs and Deformed Bar Anchors:
 - 1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.
 - 2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.
 - 3. Remove ceramic ferrules from studs and work after welding.

3.4 CORRECTIVE MEASURES

- A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and erection of structural steel, and steel deck.
- B. Compensation for Additional Services: Should additional work by Design Professionals such as design, drafting, meetings and/or visits be required which are necessitated by failure of the Contractor to perform the work in accordance

with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

[Balance of page blank; see form on next page]

Structural Substitution Request Form – to be completed by Contractor

Project:		Substitution Request #
Date:		
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule¹ (check one): ☐ NONE ☐ See Attached5. Effect on Owner's Cost² attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA6. Effect on Construction Documents³ (design work anticipated): ☐ NONE ☐ See Attached7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT
APPLICABLE8. Effect on Other Trades⁴:9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See

Attachment

Signature⁵:

Date:

Company:

General Contractor Signature⁵:

Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.

2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.

3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.

4. Contractor is responsible for effects on other trades from this substitution;

General Contractor must review and agree effects on other trades are fairly represented in items 4-9.

5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void

6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

Ramapo College of New Jersey
College Commons
RCNJ Project 12-281C

Structural Steel
051200 - 28

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

END OF SECTION

SECTION 055000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Steel framing and supports for secondary framing members to support items indicated.
- 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- 3. Prefabricated attic stairways.
- 4. Metal bollards.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing items cast into concrete.
- 2. Section 099100 "Painting."

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Manufactured products.
- 2. Paint products.
- 3. Grout.

- B. Shop Drawings: Show fabrication and installation details.

- 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

- C. Samples for Verification: For each type of exposed metal finish required.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 666, Type 304 or Type 316L.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 or Type 316L.
- D. Stainless Steel Tubing: ASTM A 554, Grade MT 304.
- E. Steel Plates, Shapes, and Bars: ASTM A 36.
- F. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 1. Size of Channels: 1-5/8 by 1-5/8 inches, unless otherwise indicated.
 2. Material: Galvanized steel, ASTM A 653, structural steel, Grade 33, with G90 coating; minimum 0.079-inch nominal thickness.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or **ASTM F 1941**, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 307, Grade A**; with hex nuts, **ASTM A 563**; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, **ASTM F 593**; with hex nuts, **ASTM F 594**; and, where indicated, flat washers; Alloy Group **1** or Group **2**.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, **ASTM A 563**; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: **ASME B18.6.3**.
- G. Lag Screws: **ASME B18.2.1**.
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, **ASME B18.22.1**.
- J. Lock Washers: Helical, spring type, **ASME B18.21.1**.
- K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- L. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- M. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941**, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group **1** or Group **2** stainless-steel bolts, **ASTM F 593**, and nuts, **ASTM F 594**.
- N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, **1-5/8 by 7/8 inches** by length indicated with anchor straps or studs not less than **3 inches** long at not more than **8 inches** on center. Provide with

temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer with a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 1. Use primer with a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, **1/8 by 1-1/2 inches**, with a minimum **6-inch** embedment and **2-inch** hook, not less than **8 inches** from ends and corners of units and **24 inches** on center unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Exterior Assemblies: Galvanize all miscellaneous framing and supports.
- D. Interior Assemblies: Shop-prime miscellaneous framing and supports.
 - 1. Prime miscellaneous framing and supports with zinc-rich primer where indicated.
 - 2. Galvanize miscellaneous framing and supports that are to be embedded in concrete.

2.6 PREFABRICATED ATTIC STAIRWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Louisville Ladder, Inc.
 - 2. Lynn Ladder & Scaffolding, Inc.
 - 3. Werner Company.

- B. General: Comply with ANSI/ASC A14.9 "Safety Requirements for Disappearing Attic Stairways."
- C. Attic Stairways: Prefabricated, aluminum folding ladder assembly including door and frame, complying with requirements indicated.
 - 1. Size: As indicated on Drawings.
 - 2. Minimum load capacity: 375 pounds.
 - 3. Fabricate all folding ladder components, hardware and side rails from aluminum.
 - 4. Door Material: Plywood panel, exposed surface touch sanded; with lumber edges.
 - 5. Frame Material: Dressed lumber, all four sides.
 - 6. Provide non-marring rubber shoes at bottom of ladder feet in contact with floor surfaces.
 - 7. Aluminum Steps: Slip-resistant.
 - 8. Opening Device: Cord rope or chain.

2.7 METAL BOLLARDS

- A. Fabricate metal bollards from stainless steel tubing.
 - 1. Cap bollards with 1/4-inch thick stainless steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate sleeves for bollard anchorage from galvanized steel pipe or tubing with 1/4-inch thick galvanized steel plate welded to bottom of sleeve. Fabricate length of sleeves to dimensions indicated and 3/4 inch larger than outside dimension of bollards.

2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide galvanized loose bearing and leveling plates for steel or structural items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153, for galvanizing steel and iron hardware.
 - 3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.11 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
 - 1. Run grain of directionally textured finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING PREMANUFACTURED PRODUCTS

- A. Prefabricated Attic Stairways: Install products in accordance with manufacturer's written instructions and recommendations.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.4 INSTALLING METAL BOLLARDS

- A. Coordinate bollard installation with electrical work required for installation of the following:

1. Controls for door operators.
 2. Lighting fixtures.
 3. Other devices.
- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout approximately **1/8 inch** to promote positive drainage away from bollard.
- C. Do not fill bollards with concrete.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Framing with dimension lumber.
- 2. Framing with timber.
- 3. Framing with engineered wood products.
- 4. Wood blocking and nailers.
- 5. Wood furring and grounds.
- 6. Plywood panels.

- B. Related Requirements:

- 1. Section 06 20 13 "Exterior Finish Carpentry."
- 2. Section 06 20 23 "Interior Finish Carpentry."

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- B. Timber: Lumber of 5 inches nominal size or greater in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.
 - 4. WCLIB: West Coast Lumber Inspection Bureau.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Wood Treatment Data:

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES showing compliance with building code:
1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Power-driven fasteners.
 5. Metal framing anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated, certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Plywood Panels:
1. Comply with requirements of DOC PS 1 and APA - The Engineered Wood Association.
 2. Comply with applicable recommendations in APA Form No. E30U, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
 3. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 4. Factory mark panels to indicate compliance with applicable standard.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC U1.
1. Uses:
 - a. Use Category UC2 for interior construction not in contact with the ground.
 - b. Use Category UC3b for exterior construction not in contact with the ground.
 - c. Use Category UC4a for items in contact with the ground.
 2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.
4. Wood members including framing, blocking, furring, and similar concealed members in exterior assemblies.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
 3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency acceptable to authorities having jurisdiction.
- E. Application: Treat items indicated on Drawings, and as indicated.

2.4 DIMENSION LUMBER FRAMING

- A. Grade: Construction or No. 2.
- B. Acceptable Species:
 1. Hem-fir (north); NLGA.
 2. Hem-fir; WCLIB or WWPA.
 3. Douglas fir-larch; WCLIB or WWPA.
 4. Douglas fir-larch (north); NLGA.
 5. Douglas fir-south; WWPA.
 6. Southern pine or mixed southern pine; SPIB.
 7. Spruce-pine-fir; NLGA.
 8. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

- C. Maximum Moisture Content: 19 percent.

2.5 TIMBER FRAMING

- A. Grade: Select Structural.
- B. Acceptable Species:
 - 1. Douglas fir-larch; WCLIB, or WWP.
 - 2. Douglas fir-larch (north); NLGA.
 - 3. Douglas fir-south; WWP.
- C. Maximum Moisture Content: 20 percent.
- D. Additional Restriction: Free of heart centers.

2.6 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no formaldehyde.
 - 1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Boise Cascade Company.
 - b. Finnforest USA.
 - c. Georgia-Pacific Building Products.
 - d. Jager Building Systems, Inc.
 - e. Louisiana-Pacific Corporation.
 - f. Pacific Woodtech Corporation.
 - g. Roseburg Forest Products.
 - h. Weyerhaeuser Company.
 - 2. Comply with requirements indicated on Drawings.

2.7 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.
- B. Grade: Construction or No. 2.
- C. Acceptable Species:

1. Hem-fir (north); NLGA.
2. Hem-fir; WCLIB or WWPA.
3. Douglas fir-larch; WCLIB or WWPA.
4. Douglas fir-larch (north); NLGA.
5. Douglas fir-south; WWPA.
6. Southern pine or mixed southern pine; SPIB.
7. Spruce-pine-fir; NLGA.
8. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

D. Maximum Moisture Content: 19 percent.

E. For blocking, nailers and furring used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.8 PLYWOOD PANELS

- A. Plywood Panels: APA Rated Sheathing, Group 1, Exposure 1, in thickness indicated or, if not indicated, not less than **1/2-inch** nominal thickness.
- B. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than **3/4-inch** nominal thickness.

2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated and that comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153 or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272 or fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: **ASME B18.2.1**.
- F. Bolts: Steel bolts complying with **ASTM A 307, Grade A**; with **ASTM A 563** hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.10 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Cleveland Steel Specialty Company.
 2. KC Metal Products, Inc.
 3. Phoenix Metal Products, Inc.
 4. Simpson Strong-Tie Company, Inc.
 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated for basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Galvanized steel is typical for most manufacturers and is suitable for most applications.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304 or Type 316.
1. Use for exterior locations and where indicated.
- F. Joist Hangers: U-shaped joist hangers with 2-inch long seat and 1-1/4-inch wide nailing flanges at least 85 percent of joist depth.
1. Thickness: 0.050 inch, unless otherwise indicated.
- G. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.
- H. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

2.11 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Adhesives for Gluing: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. VOC Content Limits: Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- H. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than **16 inches** on center.

- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls at ceiling with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at ceiling, accurately fitted to close cavity spaces. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
- K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code 2009/New Jersey Edition.
 - 2. NES NER-272 or ICC-ES evaluation report for power-driven fasteners.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WALL FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
- B. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- C. Construct corners and intersections with three or more studs.
- D. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers of depth indicated, and if not indicated, as follows:
 - a. Not less than 4-inch nominal depth for openings 48 inches and less in width.
 - b. Not less than 6-inch nominal depth for openings 48 to 72 inches in width.
 - c. Not less than 8-inch nominal depth for openings 72 to 120 inches in width.
 - d. Not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

3.3 JOIST FRAMING INSTALLATION

- A. Joists: Install with crown edge up and support ends of each member with not less than **1-1/2 inches** of bearing on wood or metal, or **3 inches** on masonry. Attach as indicated on Drawings, and if not indicated, as follows:
 - 1. Where supported on wood members, by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds **48 inches**.
- C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than **2 inches** from top or bottom.
- D. Provide solid blocking of **2-inch nominal** thickness by depth of joist at ends of joists unless nailed to header or band.
- E. Lap members framing from opposite sides of beams, girders, or partitions not less than **4 inches** or securely tie opposing members together. Provide solid blocking of **2-inch nominal** thickness by depth of joist over supports.
- F. Anchor members paralleling masonry with **1/4-by-1-1/4-inch** metal strap anchors spaced not more than **96 inches** on center, extending over and fastening to three joists, unless otherwise indicated.
- G. Provide bridging of type indicated below, at intervals of **96 inches** on center between joists, unless otherwise indicated.
 - 1. Diagonal wood bridging formed from bevel-cut, **1-by-3-inch nominal** size lumber, double-crossed and nailed at both ends to joists.
 - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.4 TIMBER FRAMING INSTALLATION

- A. Install wood posts level and plumb using metal anchors indicated.

3.5 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.6 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Space members as indicated on Drawings.

3.7 PLYWOOD PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30U, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- C. Do not use materials with defects that impair quality of panels or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- E. Do not bridge building expansion or other movement joints; cut and space edges of panels to match spacing of structural support elements.
- F. Space panels **1/8 inch** apart at edges and ends.
- G. Fasten panels to substrates indicated.
- H. Fastening Methods: Fasten panels to supports with screws.

3.8 PROTECTION

- A. Protect rough carpentry from weather.

END OF SECTION 06 10 00

SECTION 062013

EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior wood trim.
- 2. Exterior wood slat fencing.

- B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
- 2. Section 06 20 23 "Interior Finish Carpentry."
- 3. Section 09 91 00 "Painting" for field-applied finishes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit drawings showing locations of each item, dimensioned plans and elevations, large-scale details, materials, dimensions, profiles, attachment devices, and other components.
- C. Samples for Verification:
 - 1. Lumber species for opaque finish: 12-inch long samples for each profile required.

1.4 INFORMATIONAL SUBMITTALS

- A. Compliance Certificates: For lumber that is not marked with grade stamp.

1.5 QUALITY ASSURANCE

- A. Quality Standard: Fabricate and install exterior finish carpentry in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published

jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.

1. Quality Grade for Woodwork: Custom grade, unless otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber materials during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Stack lumber flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber Standards: Comply with applicable provisions of the following standards for each type of finish carpentry and quality grade specified. Where standards conflict the more stringent shall apply.
 1. AWS Section 3.
 2. DOC PS 20 and applicable rules of grading agencies indicated.
- B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 EXTERIOR TRIM AND FENCING SLATS

- A. Lumber for Field-Applied Opaque Paint Finish: Provide lumber surfaced 4 sides (S4S) and complying with requirements indicated.
 1. AWS Grade: Custom.
 2. Acceptable Species and Grading Agency:
 - a. Baldcypress: NLGA, WCLIB, or WWPA.
 - b. Western red cedar: NLGA, WCLIB, or WWPA.
 - c. Northern white cedar: NeLMA or NLGA.
 - d. Douglas fir: NeLMA, NLGA, WCLIB, or WWPA.
 - e. Fir-tamarack: NeLMA, NLGA, WCLIB, or WWPA.
 3. Maximum Moisture Content: Kiln dry lumber to maximum moisture content of 15 percent with at least 85 percent of shipment at 12 percent or less..
 4. Profiles and Dimensions: Comply with requirements indicated on Drawings.
 5. Finger Jointing: Not allowed.
 6. Gluing for Width: Not allowed.
 7. Face Surface: Surfaced (smooth).
 8. Factory Priming: Factory coated on faces and edges, with exterior primer compatible with topcoats specified.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide fasteners of appropriate size and type to secure exterior finish carpentry materials.
 1. Materials: Provide stainless-steel or hot-dip galvanized-steel fasteners.

2.4 FABRICATION

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Complete fabrication, including assembly, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
- C. Fabricate carpentry to dimensions, profiles, and details indicated.
 1. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, or other defects affecting serviceability or appearance.

2. Accurately fit all joints, corners and miters.
 3. Conceal all fasteners to greatest extent.
- D. Shop cut openings to maximum extent possible, to receive hardware and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- E. Backout or kerf backs of flat trim members, except for members with ends exposed in finished work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber to be painted including both faces and edges, unless factory primed. Comply with requirements in Section 09 91 00 "Painting."

3.3 INSTALLATION, GENERAL

- A. General: Install finish carpentry to comply with referenced quality standard.
 1. Install carpentry level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
 2. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; or too small to fabricate with proper jointing arrangements.
 3. Scribe and cut carpentry to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
 4. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 5. Install carpentry to tolerance of **1/8 inch in 96 inches** for level and plumb. Install adjoining finish carpentry with **1/32-inch** maximum offset for flush installation and **1/16-inch** maximum offset for reveal installation.

3.4 TRIM INSTALLATION

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related trim members.
- B. Fit exterior joints to exclude water. Cope joints at returns and miter at inside and outside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
- C. Install trim without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
 - 1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.6 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are moisture damaged or mold damaged.
 - 1. Indications that materials are moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 13

SECTION 062023
INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Interior wood trim.
- 2. Interior door frames.
- 3. Manufactured trimless door frames.

B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
- 2. Section 06 20 13 "Exterior Finish Carpentry."
- 3. Section 08 71 00 "Door Hardware."
- 4. Section 09 91 00 "Painting" for field-applied finishes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Shop Drawings: Submit drawings showing locations of each item, dimensioned plans and elevations, large-scale details, materials, dimensions, profiles, attachment devices, and other components.

C. Samples for Verification:

- 1. Lumber species for transparent finish: 12-inch long samples for each profile required.
- 2. Provide sample sets containing a minimum 3 or more samples to demonstrate the proposed full range of appearance characteristics to be expected in completed work.

1.4 INFORMATIONAL SUBMITTALS

- A. Compliance Certificates: For lumber that is not marked with grade stamp.

1.5 QUALITY ASSURANCE

- A. Quality Standard: Fabricate and install interior finish carpentry in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.
 - 1. Quality Grade for Woodwork: Custom grade, unless otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber materials during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Stack lumber flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- C. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where finish carpentry is indicated to fit to other construction, verify actual dimensions of other construction by accurate field measurements and indicate measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber Standards: Comply with applicable provisions of the following standards for each type of finish carpentry and quality grade specified. Where standards conflict the more stringent shall apply.
 - 1. AWS Section 3.
 - 2. DOC PS 20 and applicable rules of grading agencies indicated.
- B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 INTERIOR TRIM AND DOOR FRAMES

- A. Hardwood Lumber for Field-Applied Transparent Finish: Provide lumber surfaced 4 sides (S4S) and complying with requirements indicated.
 - 1. AWS Grade: Custom.
 - 2. Species: Walnut.
 - 3. Cut: Quarter sawn.
 - 4. Matching: Selected for compatible grain and color.
 - 5. Maximum Moisture Content: Kiln dry lumber to maximum moisture content of 10 percent.
 - 6. Profiles and Dimensions: Comply with requirements indicated on Drawings.
 - 7. Finger Jointing: Not allowed.
 - 8. Gluing for Width: Not allowed.
 - 9. Face Surface: Surfaced (smooth).

2.3 TRIMLESS DOOR FRAMES

- A. Door Frames: Manufactured, two-piece, adjustable, slip-on type drywall frames fabricated from galvanized steel sheet, with perforated anchorage flanges to receive joint compound for concealment; provide with manufacturer's accessories required for a complete installation.
 - 1. Basis of Design: "EZY Jamb"; EzyJamb USA.
 - 2. Profiles and Dimensions: Comply with requirements indicated on Drawings.
 - 3. Prepare frames to receive door hardware items indicated:
 - a. Strike plate assembly.
 - b. Hinges.
 - 4. Exposed Metal Finish: Shop-primed.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure and concealed attachment.

2.5 FABRICATION

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Complete fabrication, including assembly, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
- C. Fabricate carpentry to dimensions, profiles, and details indicated.
 - 1. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, or other defects affecting serviceability or appearance.
 - 2. Accurately fit all joints, corners and miters.
 - 3. Conceal all fasteners to greatest extent.
- D. Shop cut openings to maximum extent possible, to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- E. Door Frames: Frames shall be provided in single piece lengths of solid stock lumber. Form frames with dadoes or rabbeted joints.
- F. Backout or kerf backs of flat trim members, except for members with ends exposed in finished work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

- A. General: Install finish carpentry to comply with referenced quality standard.
 - 1. Install carpentry level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
 - 2. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; or too small to fabricate with proper jointing arrangements.
 - 3. Scribe and cut carpentry to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
 - 4. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 5. Install carpentry to tolerance of **1/8 inch in 96 inches** for level and plumb. Install adjoining finish carpentry with **1/32-inch** maximum offset for flush installation and **1/16-inch** maximum offset for reveal installation.

3.4 TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than **24 inches** long, except where necessary
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger joints in adjacent and related trim members.
 - 3. Cope joints at returns, miter at inside and outside corners, to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 5. Match color and grain pattern of trim for transparent finish across joints.
- B. Install trim after gypsum-board joint finishing operations are completed.
- C. Install trim without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 TRIMLESS DOOR FRAME INSTALLATION

- A. Comply with manufacturer's written instructions for installation and performance of work.

- B. Set frames accurately in position, plumb and align, with no distortions and with no variations in flushness of adjoining surfaces.

3.6 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.
 - 1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.7 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas.

3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 23

SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation.

B. Related Sections:

1. Section 092900 "Gypsum Board" for sound attenuation insulation for gypsum board assemblies.

1.2 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosum on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a qualified testing and inspecting agency acceptable to authorities having jurisdiction. Identify products and materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville; a Berkshire Hathaway company.
 - 3. Knauf Insulation.
 - 4. Owens Corning.
- A. Sustainability Requirement: Provide low-emitting glass-fiber board insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde as certified by the Greenguard Environmental Institute.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Thickness: 3-1/2 inches, except as otherwise indicated.
 - 2. R-value: 11, except as otherwise indicated.
 - 3. Application: Miscellaneous applications indicated on Drawings.

2.2 MISCELLANEOUS INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - 1. Products:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 1. Products:
 - a. AGM Industries, Inc.; RC150 or SC150.
 - b. Gemco; Dome-Cap, R-150 or S-150.
 - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.
 - 1. Products: Gemco; Clutch Clip.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 - 1. Products:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.
 - 2. VOC Content Limits for Adhesives: Provide adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Adhesives: 65 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF CONCEALED BUILDING INSULATION

- A. General: Comply with manufacturer's written instructions to apply insulation to substrates by method indicated. Provide permanent placement and support of units.
- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain **required** clearances of insulation around recessed lighting fixtures and electrical devices not rated for or protected from contact with insulation.
 - 4. Where cavity heights exceed **96 inches**, provide supplemental spindle-type insulation anchors to support unfaced insulation blankets mechanically in addition to friction fitting.
- C. Miscellaneous Mechanical Attachment of Insulation with Spindle-Type Anchors:
 - 1. Fasten insulation anchors to substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. After adhesive has dried, press insulation into position over spindles and secure tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 - 3. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 072500
FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible flashings.
- B. Related Requirements:
 - 1. Section 076200 "Sheet Metal Flashing and Trim."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and extent of flexible flashings. Include plans and details of flexible flashing applications including terminations.
 - 1. Minimum Drawing Scale (Plans): 1/2 inch = 1 foot.
 - 2. Minimum Drawing Scale (Details): 3 inch = 1 foot.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, and date of manufacture.
- B. Store rolls according to manufacturer's written instructions within temperature range required by manufacturer.
- C. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Apply flashing within the range of ambient and substrate temperatures recommended by manufacturer.

1. Protect substrates from environmental conditions that affect performance of flashing.
2. Do not apply flashing to a damp or wet substrate.

PART 2 - PRODUCTS

2.1 FLEXIBLE FLASHING

- A. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun-bonded polyolefin to produce an overall thickness of not less than **0.040 inch**.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc; CCW-705-TWF Thru-Wall Flashing.
 - b. Grace Construction Products; W.R. Grace & Co. -- Conn.; Vycor V40 Self-Adhered Flashing.

2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by flashing manufacturer for intended use and compatible with flashing.
- B. Primer: Product recommended in writing by flashing manufacturer for substrate conditions.
- C. Termination Mastic: Manufacturer's cold fluid-applied elastomeric liquid; trowel grade.
- D. Adhesive and Tape: Manufacturer's standard adhesive and pressure-sensitive adhesive tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions.

3.3 FLEXIBLE FLASHING INSTALLATION

- A. General: Install flexible flashing and auxiliary materials to comply with manufacturer's written instructions to achieve continuous watertight seals.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least **4 inches** except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.4 CLEANING AND PROTECTION

- A. Protect flashing from damage during application and remainder of construction period, according to manufacturer's written instructions.

END OF SECTION 07 25 00

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal wall flashing and counterflashing for exterior assemblies.

B. Related Requirements:

1. Section 072500 "Flexible Flashing."

1.2 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.
- C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of special conditions.
6. Details of connections to adjoining work.
7. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, dead soft, fully annealed.
 1. Finish: 2D (dull, cold rolled).
 2. Surface: Smooth, flat.

2.2 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant Materials: Silicone sealant; provide products specified in Section 079200.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 feet** on slope and location lines as indicated and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with elastomeric sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 SHEET METAL FLASHINGS

- A. Wall Flashing and Counterflashing: Fabricate from 0.0187 inch stainless steel sheet.
 - 1. Fabricate continuous flashings in minimum **96-inch** long, but not exceeding **12-foot** long, sections, for through-wall flashings, flashings under copings, at shelf angles, and where indicated.
 - 2. Fabricate discontinuous lintel, sill, and similar flashings to extend **8 inches** beyond each side of wall openings. Form with minimum **2-inch** high, end dams where flashing is discontinuous.
 - 3. Fabricate through-wall metal flashing embedded in masonry with ribs at **3-inch** intervals along length of flashing to provide an integral mortar bond.
 - 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 - 5. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing **1/2 inch** out from wall, with outer edge bent down 30 degrees and hemmed.
 - 6. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself (hem) **1 inch** or at least depth of sealant joint at exterior face of wall to form a stop for retaining sealant and backer rod.
 - 7. Metal drip edges: Extend at least **3 inches** into wall or veneer and **1/2 inch** out from wall, with outer edge bent down 30 degrees and hemmed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than **12 inches** apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
 1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet** with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with elastomeric sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate substrates not less than **1-1/4 inches** for nails and not less than **3/4 inch** for wood screws.
- E. Seal joints elastomeric sealant as required for watertight construction.
 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than **1 inch** into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between **40 and 70 degrees F**, set joint members for 50 percent movement each way. Adjust setting

- proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 degrees F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- A. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 6 inches over base flashing. Lap counterflashing joints a minimum of 6 inches and bed with sealant. Secure in a waterproof manner.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the applications indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Field-Adhesion-Test Reports: For each sealant application tested.
- B. Installer Warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Exposed sealant work shall be performed by a single firm specializing in the installation of sealants who has successfully produced work comparable to this project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years. Concealed sealant work shall be the responsibility of the subcontractor whose work requires concealed or internal sealant applications.

- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 degrees F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty excludes deterioration or failure of joint sealants from the following:
 - a. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - b. Disintegration of joint substrates from causes exceeding design specifications.
 - c. Mechanical damage caused by individuals, tools, or other outside agents.
 - d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
 - 2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

2.2 MATERIALS, GENERAL

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application, based on testing and field experience.
- C. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Provide elastomeric sealants that are nonstaining to porous substrates as demonstrated by testing according to ASTM C 1248.
- C. Single-Component Neutral-Curing Silicone Sealant:
 - 1. Products: Provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials; SilPruf LM SCS2700.
 - c. Pecora Corporation; 864 or 890.
 - d. Tremco; Spectrem 3 or Spectrem 1.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, O.
6. Application: Joints in exterior wall assemblies and concealed metal flashing joints (moving joints).

D. Single-Component Neutral-Curing Silicone Sealant:

1. Products: Provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. Pecora Corporation; 301 NS or 311 NS.
 - c. Tremco Incorporated; Spectrem 800.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, O.
6. Application: Joints in exterior paving or pavements (moving joints).

E. Single-Component Mildew-Resistant Silicone Sealant:

1. Products: Provide one of the following:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Advanced Materials; Sanitary SCS1700.
 - c. Pecora Corporation; 898.
 - d. Tremco; Tremsil 200 Sanitary.
2. Type and Grade: S (single component) and NS (nonsag).
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, O.
5. Provide products containing a fungicide for mildew resistance.
6. Application: Joints in interior wet areas.

F. Single-Component Pourable Urethane Sealant:

1. Products: Provide one of the following:
 - a. Pecora Corporation; Urexpan NR-201.
 - b. Sika Corporation, Inc.; Sikaflex - 1CSL.
 - c. Tremco; Tremflex S/L or Vulkem 45.
2. Type and Grade: S (single component) and P (pourable).
3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, O.
5. Application: Interior floor joints.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Provide one of the following:

- a. Bostik, Inc; Chem-Calk 300.
- b. Pecora Corporation; BC-158.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex Sealant or Siliconized Acrylic Latex Sealant: ASTM C 834, Type OP, Grade NF.

1. Products: Provide one of the following:

- a. Pecora Corporation; AC-20+Silicone.
- b. Tremco; Tremflex 834.

2. Application: Interior wall joints and perimeter of frames.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330 for type indicated. Select size, shape and density of cylindrical sealant backings in consultation with the manufacturer to control sealant depth and produce optimum sealant performance for specific project conditions of use.

1. Type C: Closed-cell polyethylene foam material with a surface skin, which is nonabsorbent to liquid water and gas, non-outgassing in unruptured state. Provide one of the following:

- a. HBR Closed Cell Backer Rod; Nomaco, Inc.
- b. Sonneborn Sonolastic Closed-Cell Backer-Rod; Building Systems Division/BASF.
- c. MasterSeal 920; BASF Master Builders.

2. Type B: Bi-cellular reticulated, polymeric foam material with a surface skin, non-outgassing, with a density of between 24-48 kg/cubic meter per ASTM D1622 and minimum tensile strength of greater than 200 kPa per ASTM D1623, and with water absorption less than 0.10 gm/cc per ASTM C1016. Provide one of the following:

- a. SofRod; Nomaco, Inc.
- b. Sonolastic Soft Backer-Rod; Building Systems Division/BASF.
- c. MasterSeal 921; BASF Master Builders.

- C. Bond-Breaker Tape: Polyethylene, TFE fluorocarbon, or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs

below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates for joint sealants in exterior wall assemblies as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform test at each building façade for each kind of sealant and joint substrate.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 081100
STEEL AND GLASS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Preglazed steel and glass door assemblies including frames.
- 2. Preglazed steel and glass sidelite assemblies.

B. Related Requirements:

- 1. Section 076200 "Flashing and Sheet Metal."
- 2. Section 079200 for perimeter joint sealants.
- 3. Section 087100 for door hardware requirements.
- 4. Section 088000 for additional glazing requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

B. Shop Drawings: Include the following:

- 1. Elevations of each door and sidelite design.
- 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
- 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 4. Details and locations of reinforcement and preparations for hardware.
- 5. Details of each different wall opening condition.
- 6. Details of anchorages, joints, and connections.
- 7. Glazing details.
- 8. Weather-stripping details.
- 9. Flashing details.
- 10. Operational clearances.

11. Perimeter sealants.

C. Samples (as requested by architect):

1. Submit minimum 18-inch x 18-inch sample showing door construction including muntins.
2. 6-inch square Samples of metal finish.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable hardware and finishes to include in operation and maintenance manuals.
- B. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member of the Steel Window Institute (SWI) with not less than 10 years experience in the fabrication of custom steel and glass door assemblies.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of products required for this Project. A firm which is specialized in the erection of steel and glass door assemblies and who has successfully installed work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years.
- C. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.
- D. Accessible Design Standards: For hardware and other operating devices, comply with requirements of the following:
 1. New Jersey Barrier-Free Subcode including technical standard ICC/ANSI A117.1.
 2. U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).
- E. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 for Category II materials.
 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- F. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or

more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

G. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of door assemblies with other exterior wall components. Include provisions for structural anchorage, flashing, weeping, perimeter joint sealants and protection of finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions.
- B. Store products in designated areas in an upright position on wood slats or on a dry floor in a manner that will prevent damage. Ventilate canvas or plastic coverings to prevent humidity buildup.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of door openings by field measurements before fabrication. Include measurement on Shop Drawings.

1.8 COORDINATION

- A. Coordinate installation of anchorages for door assemblies. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's form in which manufacturer agrees to repair or replace steel and glass doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection.
 - c. Water leakage or air infiltration.
 - d. Faulty operation of door hardware.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - f. Failure of insulating glass.
2. Warranty Period:
 - a. Doors: 10 years from date of Substantial Completion.
 - b. Metal Finishes: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Project Design and Contract Documents are based on the following:
 1. "University Series Steel and Glass Doors"; Hope's Window, Inc.
 2. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. A & S Window Associates, Inc.
 - b. Crittall Windows Ltd.
 - c. Optimum Window Manufacturing Corp.
 - d. Torrance Steel Window Co., Inc.

2.2 STEEL AND GLASS DOORS

- A. Hot-Rolled Steel Members: Provide stile, rail, muntin and frame members formed from hot-rolled, new billet steel sections. For combined weight of frame and ventilator members and front-to-back depth of frame or ventilator members, comply with the following requirements:
 1. Profiles and Styles: As indicated on Drawings.
 2. Layout and Arrangement: As indicated on Drawings.
 3. Heavy Custom Steel and Glass Door Assemblies: Not less than 3.9 lb/ft. in combined weight and not less than 1-3/4 inches deep.
 4. Heavy Custom Frame Assemblies: Not less than 1.8 lb/ft.
 5. Muntins: True divided lites.
 6. All glazing rebate surfaces shall be perpendicular to the stem of the profile and shall provide a minimum 3/4-inch unobstructed glazing surface. Applied glazing rebate extensions and tapered rebate surfaces shall not be acceptable.
 7. Metal Finish: High performance finish.
 - a. Color and Gloss: Match Architect's control sample.

- B. Glazing Stops: Manufacturer's standard extruded aluminum components; Alloy 6063-T5 with a minimum thickness of .063 inches.
- C. Fasteners: Provide fasteners of bronze, brass, or stainless steel that are warranted by manufacturer to be noncorrosive and compatible with hardware, anchors, and other components of door and sidelite assemblies.
 - 1. Exposed Fasteners: To greatest extent possible, do not use exposed fasteners. Where exposed fasteners are unavoidable, provide Phillips flat-head machined screws that match finish of member or hardware being fastened, as appropriate.
- D. Anchors and Clips: Provide units of stainless steel, bronze, or brass. Provide units with sufficient strength to withstand design pressure indicated.
- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when doors are closed.
 - 1. Weather-Stripping Material: Manufacturer's standard extruded EPDM, closed cell sponge, closed cell neoprene, or flexible silicone.
- F. Sealant: For sealants required within fabricated door and sidelite assemblies, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

- A. Insulating Glass Units: Provide products specified in Section 088000 "Glazing."
- B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 DOOR HARDWARE

- A. Provide products specified in Section 087100 "Door Hardware."

2.5 FABRICATION

- A. General: Fabricate door and sidelite assemblies to the designs, shapes, sizes, thicknesses and configurations shown using the materials and components specified. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site. Carefully cut and fit all components.
 - 1. Factory glaze doors and sidelites.
 - 2. Factory assemble components and factory install hardware to greatest extent possible.
- B. Fabricate all door assemblies to accommodate swing direction shown.

- C. Fabricate door stile and rail members of hot-rolled steel of profile indicated. Miter or cope corners, and weld and dress joints smooth.
- D. Fabricate muntins slotted, cross notched and welded to stiles and rails. All interior and exterior muntin joints shall be welded and ground smooth.
- E. Glazing Stops: Provide snap-on glazing stops; coordinate with Section 08 80 00 "Glazing" and with glazing system indicated.
 - 1. Provide glazing stops to fit operable muntin profiles.
 - 2. Finish glazing stops to match doors.
- F. Lock boxes and lock stiles shall be composite profiles as shown on the shop drawings and glazed into the door leaves.
- G. Weatherstrips:
 - 1. Door Leaves: Continuous triple or neoprene weatherstripping applied to integral weatherstrip grooves in the interior and exterior contact surfaces of head and jambs of door stiles, rails, and frames.
 - a. Surface applied weatherstrips by means of additional retainers or screw fasteners shall not be accepted.
 - 2. Sill Members: Applied either to integral T-slot in threshold or to the underside of the door.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 STEEL FINISHES

- A. High-Performance Finish: Manufacturer's high performance, ultrathane polyurethane finish; prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating manufacturers' written instructions.
 - 1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".
 - 2. Pretreatments:
 - a. Alkaline cleaning spray.
 - b. Alkaline cleaning – submersion.
 - c. Water immersion rinse combo.
 - d. Water immersion rinse clean.
 - e. Acid immersion.
 - f. Neutralizing rinse.
 - g. Water immersion rinse clean.

- h. Conditioner immersion.
 - i. Zinc phosphate immersion.
 - j. Rinse immersion.
 - k. Sealer immersion.
 - l. Water reverse osmosis rinse immersion.
 - 3. Epoxy E-Coat Primer: All pickled and pretreated frames and accessories are immersed into an electrostatic (E-coat) bath of PPG epoxy primer to ensure all substrates are encapsulated evenly and completely. Use of spray primers only will not be acceptable.
 - a. Permeate spray.
 - b. Permeate rinse.
 - c. Epoxy primer immersion and electrostatic encapsulation.
 - d. Water reverse osmosis rinse.
 - e. Oven-cure, 45 minutes @ 350 degrees F.
 - 4. Epoxy Powder Primer: Following pre-treatments and E-coat system, all frames and accessories shall receive an abrasion resistant powder coating prior to final top-coat.
 - a. Powder is applied electrostatically over cured E-coat to a dry film thickness (DFT) of 2.0-3.0 mils.
 - b. Parts oven baked at 325 degrees F to completely cure prior to final top coat.
 - 5. Ultrathane Polyurethane Top Coat: Following all pre-treatments, e-coat and powder abrasion layer, apply ultrathane polyurethane finish to all window components.
 - 6. Total Coating System: Combined overall dry film thickness shall be a minimum of 4.6 mils.
- B. Performance Standards: Comply with applicable requirements of the following:
- 1. Acid Pickling per SSPC-SP8.
 - 2. Paint Blistering testing per ASTM D 714.
 - 3. Humidity testing per ASTM D 4585.
 - 4. Painted Products in Corrosive Environment testing per ASTM D 1654.
 - 5. Salt Spray (Fog) testing per ASTM B 117.
 - 6. Cyclic Fog/Dry Test (Prohesion) per ASTM G 85.
 - 7. Salt Fog/UV Painted Metal testing per ASTM D 5894.
 - 8. Pull Off Strength of Coating testing per ASTM D 4541.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing door assemblies and sidelites.
- B. Install products in accordance with manufacturer's written instructions and approved shop drawings unless project conditions require more stringent requirements for performance of the work.
 - 1. Install components and accessories to comply with accessible design standards.
 - 2. Do not install damaged components.
- C. Do not erect components which are warped, deformed, bowed, defaced or otherwise damaged to impair strength. Remove and replace members damaged in the process of erection.
- D. Set units level, plumb, and true to line, with uniform joints. Rigidly secure nonmovement joints.
- E. Install door hardware according to manufacturer's written instructions using concealed fasteners. Lubricate hardware and other moving parts according to manufacturer's written instructions.
- F. Maintain uniform clearances between adjacent components.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to produce smooth operation and tight fit at contact points.
- B. Clean glass surfaces and exposed metal finishes using cleaning agents recommended by manufacturer.

END OF SECTION 08 11 00

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes hollow metal doors and frames.
- B. Related Requirements:
 - 1. Section 08 14 16 "Flush Wood Doors" for wood doors installed in hollow metal frames.
 - 2. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors and frames.
 - 3. Section 09 91 00 "Painting" for field-applied coatings.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Submit drawings including schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings indicated on Architectural Drawings. Coordinate with final Door Hardware Schedule. Include the following:
 - 1. Elevations of each door type including opening size(s) and handing of doors.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Identification of hardware sets.
 - 5. Locations of reinforcement and preparations for hardware.
 - 6. Details of each different wall opening condition.

7. Details of anchorages, joints, field splices, and connections.
8. Details of louvers and accessories.
9. Details of removable stops.

1.5 QUALITY ASSURANCE

- A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:
 1. HMMA "Hollow Metal Manual."
 2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect.
- D. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amweld International, LLC.
 2. Ceco Door; ASSA ABLOY.
 3. Curries Company; ASSA ABLOY.
 4. Deansteel Manufacturing Company, Inc.

5. Pioneer Industries.
6. Republic Doors and Frames.
7. Steelcraft; an Allegion brand.

- B. Source Limitations: Obtain hollow-metal work through a single source from a single manufacturer.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled; suitable for exposed applications. For products indicated to be built into exterior walls, hot dip galvanize after fabrication in compliance with ASTM A153, Class B.
- B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled; suitable for exposed applications.
- C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with **G60** zinc (galvanized) or **A60** zinc-iron-alloy (galvannealed) coating, mill phosphatized.
- D. Frame Anchors: ASTM A 879, Commercial Steel (CS), **04Z** coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
- F. Grout: ASTM C 476, except with a maximum slump of **4 inches**, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Bituminous Coating: Cold-applied asphalt mastic, compounded for **1.5-mil** dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 INTERIOR DOORS AND FRAMES

- A. General: Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Commercial Doors and Frames: Comply with NAAMM-HMMA 861.
1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Fabricate from cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
3. Frames:
- a. Profiles and Dimensions: Comply with requirements indicated on Drawings.
 - b. Openings up to 48 inches: Fabricate from cold-rolled steel sheet, minimum thickness of 0.053 inch.
 - c. Openings greater than 48 inches: Fabricate from cold-rolled steel sheet, minimum thickness of 0.067 inch.
 - d. Construction: Full profile welded.
4. Exposed Finish: Shop primed.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. General: Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Commercial Doors and Frames: Comply with NAAMM-HMMA 861.
1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Fabricate from metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60 or A60 coating.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 3. Frames:
 - a. Profiles and Dimensions: Comply with requirements indicated on Drawings.
 - b. Fabricate from metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum G60 or A60 coating.
 - c. Construction: Full profile welded.
 4. Exposed Finish: Shop primed.

2.5 ACCESSORIES

- A. Louvers: Provide louvers for exterior doors, which comply with SDI 111C, with louver blades and frames fabricated from metallic-coated steel sheet.
 - 1. Sightproof and Storm-Resistant Louvers: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Grout Guards: Formed from same material as frames, not less than **0.016 inch** thick.
- C. Stops and Molding: Provide stops and moldings around louvers.
 - 1. Form fixed stops and moldings integral with frame, on the exterior (non-secured) side of the frame.
 - 2. Provide removable stops and moldings formed of same materials as frames. Secure with countersunk oval head machine screws spaced uniformly not more than **12 inches** on center. Form corners with butted or mitered hairline joints.
 - 3. Coordinate rabbet width between fixed and removable stops with louver installation.

2.6 FRAME ANCHORS

- A. Jamb Anchors: Stud-wall type; designed to engage stud, welded to back of frames; formed of same material and thickness as frames but not less than **0.042 inch** thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of **0.093 inch**, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than **2-inch** height adjustment. Terminate bottom of frames at finish floor surface.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid, neat in appearance, and free of defects, warp, wave and buckle. Accurately form metal to required sizes and profiles indicated, with minimum radius for metal thickness. Accurately machine, file, and fit exposed connections with hairline joints. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
- B. Exposed Fasteners: Provide countersunk flat heads for exposed screws and bolts, unless otherwise indicated.
- C. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness **0.026 inch**, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than **6 inches** apart. Spot weld to face sheets no more

- than **5 inches** on center. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Vertical Edges for Single-Acting Doors: Bevel edges **1/8 inch in 2 inches**.
 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- D. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than **18 inches** from top and bottom of frame. Space anchors not more than **32 inches** on center and as follows:
 - 1) Three anchors per jamb up to **60 inches** in height.
 - 2) Four anchors per jamb from **60 to 90 inches** in height.
 - 3) Five anchors per jamb from **90 to 96 inches** in height.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each **24 inches** or fraction thereof above **96 inches** in height.
 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final hardware schedule and templates provided by hardware supplier. Secure reinforcement by spot welding. Comply with applicable requirements of ANSI/BHMA A156.115 and A156.115-W, and ANSI/SDI A250.6 specifications for door and frame preparation for hardware. Factory-reinforce doors and frames to receive surface-applied hardware. Factory drill

and tap for surface-applied hardware, except at pushplates and kickplates provide reinforcing only.

1. Locate hardware as indicated on the Drawings or in Section 08 71 00 "Door Hardware" or, if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

2.8 METALLIC-COATED STEEL FINISHES

- A. General: Clean, treat and prime surfaces of fabricated hollow metal door and frame work, inside and out, whether exposed or concealed in the construction.
- B. Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.
 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for zinc-coated steel; compatible with substrate and field-applied finish paint system indicated.

2.9 STEEL SHEET FINISHES

- A. General: Clean, treat and prime surfaces of fabricated hollow metal door and frame work, inside and out, whether exposed or concealed in the construction.
- B. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale, shavings, filings, and rust, if present, complying with SSPC-SP 3, "Power Tool Cleaning."
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.
 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI/SDI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with referenced standards, approved Shop Drawings, and manufacturer's written recommendations and installation instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames to comply with NAAMM-HMMA 840
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install frames with removable stops located on secure side of opening.
 - b. Install door silencers in frames before grouting.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - e. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb that extends to floor, and secure with post-installed expansion anchors.
 - 3. Wood-Stud Partitions: Secure frames in place according to manufacturer's written instructions.
 - 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus **1/16 inch**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified.
 - 1. Between Door and Frame Jambs and Head: **1/8 inch** plus or minus **1/32 inch**.
 - 2. Between Edges of Pairs of Doors: **1/8 inch** to **1/4 inch** plus or minus **1/32 inch**.
 - 3. At Bottom of Door: As indicated on Drawings plus or minus **1/32 inch**.
 - 4. Between Door Face and Stop: **1/16 inch** to **1/8 inch** plus or minus **1/32 inch**.
- D. Wood Door Installation: Refer to 08 14 16 "Flush Wood Doors."
- E. Apply hardware in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - 1. Finish Painting: Refer to Section 09 91 00 "Painting"
- D. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.
- E. Institute protective measures required throughout the remainder of the construction period to ensure that the hollow metal doors and frames will be without damage or deterioration, at time of Substantial Completion.

END OF SECTION 08 11 13

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors flush wood doors.
2. Shop priming and factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 06 20 23 "Interior Finish Carpentry" for wood door frames.
2. Section 08 71 00 "Door Hardware."
3. Section 09 91 10 "Painting" for field finishing doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door.

1. Include details of core and edge construction.
2. Include factory-finishing specifications.

B. Shop Drawings: Drawings indicating location, size, thickness, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; use same reference numbers for details and openings indicated on Architectural Drawings. Coordinate with final Door Hardware Schedule. Include the following:

1. Details of each different wall opening condition.
2. Identification of hardware sets.
3. Dimensions and locations of blocking.
4. Dimensions and locations of mortises and holes for hardware.
5. Dimensions and locations of cutouts.
6. Undercuts.
7. Requirements for veneer matching.
8. Factory finishing and shop priming requirements.

- C. Samples for Verification: For transparent finish, provide set of 3 Samples demonstrating typical range for face veneer, color and grain to be expected in finished Work.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty.

1.5 QUALITY ASSURANCE

- A. Quality Standard: Comply with the applicable provisions and recommendations of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period. Do not expose doors to sudden changes in temperature.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
 2. Eggers Industries.
 3. Marshfield DoorSystems, Inc.
 4. Oshkosh Door Company.
 5. VT Industries Inc.

2.2 FLUSH WOOD DOORS, GENERAL

- A. General:
1. Comply with referenced quality standard.
 2. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain added formaldehyde.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Doors for Transparent Finish:
1. Grade: Premium, with Grade AA faces.
 2. Face Veneer Species and Cut: Walnut, quarter sawn, matching Architect's samples.
 3. Match between Veneer Leaves: Book matched.
 4. Assembly of Veneer Leaves on Door Faces: Center balance match.
 5. Pair and Set Match: Provide for doors hung in same opening.
 6. Thickness: 1-3/4 inch, unless otherwise indicated.
 7. Materials:
 - a. Particleboard Core Material: Complying with ANSI A208.1, Grade LD-1 or Grade LD-2.
 - b. Structural Composite Lumber Core: Interior doors hung with pivot hinges, doors indicated to receive exit devices, or where doors heights exceed 8 feet.
 - c. Blocking: 5-1/2 inch wide minimum top-rail blocking at doors with closers; 5-1/2 inch bottom rail blocking at doors with kickplates consisting of minimum 1/2 inch wide single length structural composite lumber (SCL) outer band and single length SCL inner band.
 - d. Vertical Edges: 1-3/8 inch wide minimum prior to fitting, 2 ply laminated wood construction consisting of a single piece hardwood outer band, without fingerjoints, and an inner band of SCL. Outer band to match face veneer for transparent finished veneered-faced doors. Trim non-rated door width equally on both jamb edges.

- e. Crossbanding: Minimum **1/16 inch** thick, low density hardwood, composite, or high density hardboard.
8. Construction: Five or seven plies. Stiles, rails, and blocking bonded to core then entire unit abrasive planed before veneering. Crossbanding materials shall extend full width of door with grain running horizontally, tapeless spliced without voids or show through (telegraphing), and directly glued to core and blocking. Sand cross banding before application of face veneer. Face veneer shall extend full height of door with grain running vertically, tapeless spliced without voids or show through (telegraphing), and directly glued to cross band. Glue lines between face veneer, crossbanding, and blocking shall be of a type to comply with the specified warranty using the hot plate process.

2.4 DOORS FOR OPAQUE FINISH

A. Doors for Opaque Finish:

- 1. Grade: Custom.
- 2. Face Veneer: Medium-density overlay.
- 3. Thickness: **1-3/4 inch**, unless otherwise indicated.
- 4. Materials:
 - a. Particleboard Core Material: Complying with ANSI A208.1, Grade LD-1 or Grade LD-2.
 - b. Structural Composite Lumber Core: Interior doors hung with pivot hinges, doors indicated to receive exit devices, or where doors heights exceed 8 feet.
 - c. Blocking: **5-1/2 inch** wide minimum top-rail blocking at doors with closers; **5-1/2 inch** bottom rail blocking at doors with kickplates consisting of minimum **1/2 inch** wide single length structural composite lumber (SCL) outer band and single length SCL inner band.
 - d. Vertical Edges: **1-3/8 inch** wide minimum prior to fitting, 2 ply laminated wood construction consisting of a single piece hardwood outer band, without fingerjoints, and an inner band of SCL. Trim non-rated door width equally on both jamb edges.
 - e. Crossbanding: Minimum **1/16 inch (1.5-mm)** thick, low density hardwood, composite, or high density hardboard.
- 5. Construction: Five or seven plies. Stiles, rails, and blocking bonded to core then entire unit abrasive planed before veneering. Crossbanding materials shall extend full width of door with grain running horizontally, tapeless spliced without voids or show through (telegraphing), and directly glued to core and blocking. Sand crossbanding before application of face veneer. Face veneer shall extend full height of door with grain running vertically, tapeless spliced without voids or show through (telegraphing), and directly glued to cross band. Glue lines between face veneer, crossbanding, and blocking shall be of a type to comply with the specified warranty using the hot plate process.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, hardware templates, and referenced quality standard.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 09 91 00 "Painting" or door manufacturer's wood primer/sealer compatible with specified top coats.
 - 1. Surfaces shall be clean and dry before priming.
 - 2. Apply primer/sealer uniformly without bare spots, runs, or sags.

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing.
- B. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- C. Factory finish doors that are indicated to receive transparent finish.
- D. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish or System 11, catalyzed polyurethane.
 - 3. Staining: Match Architect's control sample.
 - 4. Effect: Match Architect's control sample.
 - 5. Sheen: Match Architect's control sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: Apply hardware to new doors in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." For particleboard core doors drill pilot holes of proper size for installing hinge screws. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.
1. Factory wrapping shall be maintained on new doors during construction period, and all hardware shall be installed by cutting the factory wrapping at the mounting location of the hardware item.
- B. General Door Installation Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge, matching clearances specified for factory prefitting, and to contact stops uniformly. Field cutting, fitting or trimming, if required, shall be executed in a workmanlike manner.
1. Clearances: Provide **1/8 inch** at heads, jambs, and between pairs of doors. Provide **1/8 inch** from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide **1/4 inch** from bottom of door to top of threshold unless otherwise indicated.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- E. Field-Finished Doors: Refer to Section 09 91 00 for finishing requirements:

3.3 ADJUSTING

- A. Rehang or replace doors that do not swing or operate freely.
- B. Replace doors that are damaged, warped, twisted, demonstrate core show through, are not true in plane, cannot be refinished to the satisfaction of the Architect or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.
- C. Protection: Protect wood doors to ensure that the wood door work will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 14 16

SECTION 083113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry."
 - 2. Section 092900 "Gypsum Board."
 - 3. Section 093013 "Ceramic Tiling."
 - 4. Section 099100 "Painting."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: Provide complete door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer for each type of access door assembly.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors and frames from damage during transit, job storage, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chicago Metallic Corporation.
 - 2. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - 3. Karp Associates, Inc.
 - 4. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - 5. Nystrom, Inc.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153, for galvanizing steel and iron hardware.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879, with cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.
- C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304 or Type 316. Remove tool and die marks and stretch lines, or blend into finish.
- D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- E. Frame Anchors: Same material as door face.
- F. Inserts, Bolts, and Anchor Fasteners:
 - 1. Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329, unless otherwise indicated.
 - 2. Stainless steel for stainless steel door assemblies.

2.3 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges:
 - 1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
 - 2. Locations: Ceramic tile wall surfaces.

3. Stainless-Steel Sheet for Door: Nominal 0.062 inch thickness; polished finish.
4. Frame Material: Same material, thickness, and finish as door.
5. Lock: Key-operated cylinder lock.

B. Flush Access Doors with Concealed Flanges:

1. Description: Face of door flush with wall surface, with concealed flange for gypsum board installation and concealed hinge.
2. Locations: Gypsum board wall surfaces.
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch thickness; factory primed finish.
4. Frame Material: Same material and thickness as door.
5. Lock: Key-operated cylinder lock.

C. Flush Access Doors with Trimless Frames: Glass-reinforced gypsum fabrications.

1. Locations: Gypsum board ceiling surfaces.
2. Basis of Design: "GRG Access Doors"; Chicago Metallic Corporation.
3. Door: Glass-reinforced gypsum fabrication with integral flange at perimeter; gravity-held in-place atop panel frame.
4. Frame: Glass-reinforced gypsum fabrication; nominal 3-inch width with radius corners at interior opening to precisely match door panel perimeter; outside edges square.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
 2. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Locking Hardware:
1. Quantity: Furnish number locks required to hold doors tightly closed.
 2. Keys: Furnish two keys per lock and key all locks alike.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.
- D. Finish metal fabrications after assembly.

2.6 STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
- B. Factory Primed Finish: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 1. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches.
 - 1. Finish: No. 4 bright, directional polished finish.
 - 2. Run grain of directional finishes with long dimension of each piece.
 - 3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces.
- D. Field-Applied Coatings: Comply with requirements specified in Section 099100.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 084126
ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes interior all-glass entrances.
- B. Related Sections include the following:
 - 1. Section 08710 "Door Hardware" for hardware requirements.
 - 2. Section 088000 "Glazing."

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details, including the following:
 - 1. Plans, elevations, and sections.
 - 2. Details of fittings and glazing.
 - 3. Hardware quantities, locations, and installation requirements.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Finishes: 6-inch-long sections of rails, fittings, and other items.
 - 2. Glass: 6 inches square, showing exposed-edge treatment.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For all-glass systems to include in maintenance manuals.
- B. Warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Accessible Design Standards: For hardware and other operating devices, comply with requirements of the following:
 - 1. New Jersey Barrier-Free Subcode including technical standard ICC/ANSI A117.1.
 - 2. U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).
- C. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Glazing Manual."
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with all-glass systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - b. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Blumcraft of Pittsburgh Division of C.R. Laurence.
 2. Oldcastle BuildingEnvelope™.
 3. Virginia Glass Products Corporation.
 4. Vistawall Architectural Products.

2.2 MATERIALS

- A. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.
1. Thickness: 5/8-inch, minimum.
 2. Exposed and Butt Edges: Machine ground and flat polished.
 3. Provide Kind FT (fully tempered) float glass for all safety glazing applications or hazardous condition locations, except as otherwise indicated.
 - a. Surface compression shall be equal to or greater than 10,000 psi.
 4. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 5. Comply with additional requirements specified in Section 088000 "Glazing."
- B. Aluminum Components and Extrusions: ASTM B 221, with strength and durability characteristics of not less than alloy 6063-T5.
- C. Bronze Cladding: ASTM B 36, UNS No. C22000 (commercial bronze, 90 percent copper) or alloy as standard with manufacturer.
1. Finish: Satin oxidized oil rubbed.

2.3 COMPONENTS

- A. Rails and Fittings:
1. Material: Bronze-clad aluminum.
 2. Profile and style: As indicated on Drawings.
 3. Height: As indicated on Drawings.
 4. Layout and Configuration: Comply with requirements indicated on Drawings.
- B. Sidelight Channels: Bronze-clad aluminum.
- C. Anchors and Fastenings: Concealed.
- D. Glazing Accessories: Manufacturer's standard products for the following:

1. Glazing gaskets and sealants.
2. Setting blocks, edge blocks and spacers.

2.4 HARDWARE

- A. Provide products specified in Section 087100 "Door Hardware."

2.5 FABRICATION

- A. General: Fabricate entrances to the designs, shapes, and sizes shown using the materials and components specified. To the greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.
- B. Provide holes and cutouts in glass to receive hardware, fittings, rails, and accessories before tempering glass. Drill, countersink, and chamfer holes using tooling, materials and methods which are selected and applied to prevent spalling of the cut glass surfaces at holes and cutouts. The internal surface of holes and cutouts shall be smooth with minimal roughness from drilling operations. Do not cut, drill, or make other alterations to glass after tempering.
 1. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll-wave distortion is parallel with bottom edge of door or lites.
 2. Factory assemble components and factory install hardware to greatest extent possible.
- C. Fabricate all entrances to accommodate swing direction shown.
- D. Metal components of all-glass entrances shall be cut, reinforced, drilled and tapped in strict accordance with the printed door hardware manufacturer's templates and instructions.
- E. Joints in Metal Work: All exposed metal work shall be carefully fitted and matched to produce continuity of line and design, with all joints being accurately fitted for hairline contact and rigidly secured.
- F. Exposed fasteners are not permitted.

2.6 COPPER ALLOY FINISHES

- A. General: Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 1. Comply with NAAMM's recommendations for applying designated finishes.
- B. Satin Oxidized Oil-Rubbed Finish: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: type recommended by manufacturer, air dried).
 1. Match Architect's control sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing all-glass entrances.
- B. Install all-glass entrances in accordance with manufacturer's instructions and approved shop drawings.
 - 1. Install components and accessories to comply with accessible design standards.
 - 2. Do not install damaged components.
- C. Do not erect components which are warped, deformed, bowed, defaced or otherwise damaged to impair strength. Remove and replace members damaged in the process of erection.
- D. Set units level, plumb, and true to line, with uniform joints. Rigidly secure nonmovement joints.
- E. Install door hardware according to manufacturer's written instructions using concealed fasteners. Lubricate hardware and other moving parts according to manufacturer's written instructions.
- F. Maintain uniform clearances between adjacent components.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to produce smooth operation and tight fit at contact points.
- B. Clean glass surfaces and exposed metal finishes using cleaning agents recommended by manufacturer.

END OF SECTION 084126

SECTION 085123

STEEL WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Preglazed steel window assemblies.

- B. Related Sections:

- 1. Section 076200 "Flashing and Sheet Metal."
 - 2. Section 079200 for perimeter joint sealants.
 - 3. Section 088000 for additional glazing requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- 1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

- B. Shop Drawings: Include plans, elevations, sections, details of fabrication and installation, hardware, attachments to other work, operational clearances, and the following:

- 1. Joinery details.
 - 2. Glazing details.
 - 3. Flashing and drainage details.
 - 4. Weather-stripping details.
 - 5. Perimeter sealants.

- C. Samples for Verification: For steel windows and components required, prepared on Samples of size indicated below:

- 1. Window units including glazing: Submit minimum 18-inch x 18-inch sample showing frame, sash and window muntins.
 - 2. Hardware: Full-size units.
 - 3. 6-inch square Samples of metal finish.

- D. Product Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- B. Field Quality-Control Reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable hardware and finishes to include in operation and maintenance manuals.
- B. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member of the Steel Window Institute (SWI) with not less than 10 years experience in the fabrication of custom steel window door assemblies; capable of fabricating steel windows that meet or exceed performance requirements indicated and of documenting this performance test reports and calculations.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of products required for this Project. A firm which is specialized in the installation of steel window assemblies and who has successfully installed work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years.
- C. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of steel windows with other exterior wall components. Include provisions for structural anchorage, flashing, weeping, perimeter joint sealants and protection of finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions.
- B. Store products in designated areas in an upright position on wood slats or on a dry floor in a manner that will prevent damage. Ventilate canvas or plastic coverings to prevent humidity buildup.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of steel window openings by field measurements before fabrication. Include measurement on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's form in which manufacturer agrees to repair or replace steel windows or components of steel windows that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection.
 - c. Water leakage or air infiltration.
 - d. Faulty operation of operable sash or ventilator and hardware.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - f. Failure of insulating glass.
 2. Warranty Period:
 - a. Window Units: 10 years from date of Substantial Completion.
 - b. Metal Finishes: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Project Design and Contract Documents are based on the following:
1. "University Series Casement Windows"; Hope's Window, Inc.
 2. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. A & S Window Associates, Inc.
 - b. Crittall Windows Ltd.
 - c. Optimum Window Manufacturing Corp.
 - d. Torrance Steel Window Co., Inc.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide steel windows capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing windows that are representative of those specified according to ASTM E 330:
1. Wind Loads: Determine loads in accordance with the Building Subcode based upon design wind speed, exposure and occupancy category indicated.
 - a. Design wind speed: 95 miles per hour.
 - b. Exposure category: B.
 - c. Occupancy category: II.
- B. Air Infiltration for Weather-Stripped Ventilators: Not more than 0.50 cfm/ft. of ventilator crack length with a differential pressure across the window of 1.57 lbf/sq. ft. when tested according to ASTM E 283.
- C. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of 5 gal./hr. per sq. ft. with a differential pressure across the window of 2.86 lbf/sq. ft. when tested according to ASTM E 331.

2.3 STEEL WINDOWS

- A. Window Type: Casement.
1. Sizes: As indicated on Drawings.
 2. Profiles and Arrangement: As indicated on Drawings.
- B. Hot-Rolled Steel Window Members: Provide frame and ventilator members formed from hot-rolled, new billet steel sections. For combined weight of frame and ventilator members and front-to-back depth of frame or ventilator members, comply with the following requirements:

1. Heavy Custom Windows: Not less than 3.9 lb/ft. in combined weight and not less than 1-3/4 inches deep.
2. Muntins: True divided lites.
3. Window Finish: High performance finish.

a. Color and Gloss: Match Architect's control sample.

- C. Glazing Stops: Manufacturer's standard extruded aluminum components; Alloy 6063-T5 with a minimum thickness of .063 inches.
- D. Fasteners: Provide fasteners of bronze, brass, or stainless steel that are warranted by manufacturer to be noncorrosive and compatible with hardware, anchors, and other components of steel windows.
1. Exposed Fasteners: To greatest extent possible, do not use exposed fasteners. Where exposed fasteners are unavoidable, provide Phillips flat-head machined screws that match finish of member or hardware being fastened, as appropriate.
- E. Anchors and Clips: Provide units of stainless steel, bronze, or brass. Provide units with sufficient strength to withstand design pressure indicated.
- F. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when steel window is closed.
1. Weather-Stripping Material: Manufacturer's standard extruded EPDM, closed cell sponge, closed cell neoprene, or flexible silicone.
- G. Sealant: For sealants required within fabricated windows, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.4 GLAZING

- A. Insulating Glass Units: Provide products specified in Section 088000 "Glazing."
- B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.5 HARDWARE

- A. General: Provide manufacturer's standard nonremovable, solid bronze hardware, with operating components of stainless steel, carbon steel complying with AAMA 907, brass, bronze, or other corrosion-resistant material designed to operate smoothly, to close tightly, and to lock steel window ventilators securely. Provide hardware of sufficient strength to accommodate size and weight of ventilator for which it is intended.
- B. Operating Device: Combination lever-handle and cam-type latch.
- C. Hinges: Heavy duty, aluminum-bronze pivot assembly with stainless steel pin..

- D. Lock: Lift-type, cam-action lock.
- E. Friction Shoes: Adjustable friction shoes of bronze or brass.
- F. Limit Devices: Stainless steel.

2.6 FABRICATION

- A. General: Fabricate steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.
 - 1. Factory glaze window units.
 - 2. Provide units that can be reglazed without dismantling ventilator framing.
- B. Fabricate frame and ventilator members of hot-rolled steel of profile indicated. Miter or cope corners, and weld and dress joints smooth.
- C. Fabricate muntins slotted, cross notched and welded to frames. All interior and exterior muntin joints shall be welded and ground smooth.
- D. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.
- E. Provide water-shed members above casement ventilators.
- F. Glazing Stops: Provide snap-on glazing stops; coordinate with Section 08 80 00 "Glazing" and with glazing system indicated.
 - 1. Provide glazing stops to fit operable ventilator profiles.
 - 2. Finish glazing stops to match window units.
- G. Weatherstrips: Provide continuous weatherstripping applied to integral weatherstrip grooves in interior and exterior contact surfaces of frame and ventilator sections.
 - 1. Surface applied weatherstrips by means of additional retainers or screw fasteners shall not be accepted.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.8 STEEL FINISHES

- A. High-Performance Finish: Manufacturer's high performance, ultrathane polyurethane finish; prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating manufacturers' written instructions.

1. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".
 2. Pretreatments:
 - a. Alkaline cleaning spray.
 - b. Alkaline cleaning – submersion.
 - c. Water immersion rinse combo.
 - d. Water immersion rinse clean.
 - e. Acid immersion.
 - f. Neutralizing rinse.
 - g. Water immersion rinse clean.
 - h. Conditioner immersion.
 - i. Zinc phosphate immersion.
 - j. Rinse immersion.
 - k. Sealer immersion.
 - l. Water reverse osmosis rinse immersion.
 3. Epoxy E-Coat Primer: All pickled and pretreated frames and accessories are immersed into an electrostatic (E-coat) bath of PPG epoxy primer to ensure all substrates are encapsulated evenly and completely. Use of spray primers only will not be acceptable.
 - a. Permeate spray.
 - b. Permeate rinse.
 - c. Epoxy primer immersion and electrostatic encapsulation.
 - d. Water reverse osmosis rinse.
 - e. Oven-cure, 45 minutes @ 350 degrees F
 4. Epoxy Powder Primer: Following pre-treatments and E-coat system, all frames and accessories shall receive an abrasion resistant powder coating prior to final top-coat.
 - a. Powder is applied electrostatically over cured E-coat to a dry film thickness (DFT) of 2.0-3.0 mils.
 - b. Parts oven baked at 325 degrees F to completely cure prior to final top coat.
 5. Ultrathane Polyurethane Top Coat: Following all pre-treatments, e-coat and powder abrasion layer, apply ultrathane polyurethane finish to all window components.
 6. Total Coating System: Combined overall dry film thickness shall be a minimum of 4.6 mils.
- B. Performance Standards: Comply with applicable requirements of the following:
1. Acid Pickling per SSPC-SP8.
 2. Paint Blistering testing per ASTM D 714.
 3. Humidity testing per ASTM D 4585.
 4. Painted Products in Corrosive Environment testing per ASTM D 1654.
 5. Salt Spray (Fog) testing per ASTM B117.
 6. Cyclic Fog/Dry Test (Prohesion) per ASTM G 85.
 7. Salt Fog/UV Painted Metal testing per ASTM D 5894.

8. Pull Off Strength of Coating testing per ASTM D 4541.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sills, and operational clearances.
- C. Examine wall flashings, weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within **3 inches** of opening.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112 and SWI Publications.
 1. Comply with manufacturer's written instructions and approved shop drawings unless project conditions require more stringent requirements for performance of the work.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 6. Seal joints watertight, unless otherwise indicated.
- B. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
- D. Install windows and components to drain condensation, water-penetrating joints, and moisture migrating within windows to the exterior.

- E. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E 2112, Section 5.12 "Dissimilar Materials."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Testing Methodology: Testing of windows for air-penetration resistance and water resistance will be performed according to AAMA 502, Test Method A, by applying same test pressures required for performance.
 - 2. Testing Extent: Test all window assemblies. Windows shall be tested after perimeter sealants have cured.
- C. Window will be considered defective if it does not pass tests and inspections.
- D. Remove and replace noncomplying windows and retest as specified above.
- E. Prepare test and inspection reports according to AAMA 502. Testing agency will interpret test results and state in each report whether tested work complies with or deviates from requirements.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sash and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- B. Clean factory-finished steel surfaces immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes.
- C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
 - 1. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. Remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 51 23

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All Door hardware indicated in the door schedule.

1.2 SUBMITTALS

- A. Make the following submittals in the order indicated, unless submitted simultaneously.
- B. Supplier Qualifications : To the Architect, for information.
- C. Product Data : Manufacturer's technical data for each item of hardware, with installation instructions.
- D. Hardware Schedule : Indicate complete designations of every item for each door.
 1. Cross-reference to designations in contract documents.
 2. Indicate door and frame sizes and materials.
 3. Explain all abbreviations, symbols, codes, etc.
 4. Indicate hardware mounting locations.
 5. Include the following information for each item :
 - a. Type, style, function, size, and finish.
 - b. Name and manufacturer.
 - c. Fastenings.
 - d. Other pertinent information.
 6. Preliminary schedule will be reviewed if accompanied by product data.
- E. Keying Schedule : Separate detailed schedule indicating clearly how each lock is keyed.

- F. Operations and Maintenance Data : For operating parts and finishes.

1.3 QUALITY ASSURANCE

- A. Qualifications of Supplier : A recognized supplier of architectural finish hardware, with warehousing facilities, who has been furnishing hardware in the vicinity of the project for not less than 2 years, and who is, or who employs, an architectural hardware consultant.
- B. Qualifications of Architectural Hardware Consultant(s) : Certified by the Door and Hardware Institute.
- C. Fire Door Hardware : Tested for compliance with NFPA 80.
 - 1. Listing in current classification publications of the following agencies will be considered evidence of acceptable testing :
 - a. Underwriters Laboratories Inc. (UL).
 - b. Other agencies acceptable to authorities having jurisdiction.
 - 2. Provide permanent labels of all hardware except hinges, indicating the listing agency and conditions of the listing.

1.4 PROJECT CONDITIONS

- A. Sequence submittal of hardware schedule with door and frame submittals, allowing adequate time for review and re-submittal, if required, so that construction is not delayed; provide adequate information for review.
- B. Furnish hardware templates to each fabricator of other work which is to be factory-prepared for the installation of hardware.
- C. Coordinate of shop drawing of such other work to confirm that adequate provisions are made for installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware at the times and to the locations required for timely installation.
- B. Provide secure lockup for hardware not yet installed.
- C. Control handling and installation of hardware item which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses. Replace lost or stolen items at no extra cost.

1.6 MAINTENANCE

- A. Provide a complete set of adjustment and maintenance tools.
- B. Installer shall provide letter of agreement to the Owner that, approximately 6 months after the acceptance of hardware in each area, the installer shall return to the manufacturer of locking devices, and accomplish the following:
 - 1. Readjust every item of hardware.
 - 2. Consult with and instruct the Owner's personnel in recommended additions to the maintenance procedures.
 - 3. Replace hardware items which have deteriorated or failed.
 - 4. Prepare a written report of current and predictable problems of substantial nature in the performance of the hardware.

PART 2 - PRODUCTS

2.1 MASTER KEYING

- A. All cylinders shall be keyed to the existing Best master key system.
- B. All cylinders shall be interchangeable core type. Provide temporary cores during construction.
- B. Arrange to have the Best representative meet with the owner's representative to establish the details of the system.
- C. Provide system master keyed cylinders for Items 101, 102, 106, 108, 109 and 111.
- D. Provide five master keys and four cut keys per cylinder/core and 100 key blanks.

2.2 HARDWARE ITEMS

- A. Hanging Devices (000)
 - 1. Furnish the type as listed.
 - 2. Catalog reference.
 - a. Hager. (Items 001 to 006.)
 - b. Simonswerk. (Item 007.)

3. Item description.

a.	001 – Mortise Hinge AB850ET – NRP – 5.0 x 4.5	Note 1	613
b.	002 – Mortise Hinge AB850ET – 5.0 x 4.5		613
c.	003 – Mortise Hinge AB700ET		641
d.	004 – Mortise Hinge AB750ET		641
e.	005 – Mortise Hinge AB850ET – NRP – 5.0 x 4.5		613
f.	006 – Mortise Hinge AB850ET – NRP		613
g.	007 – Concealed Hinge TE 340 3D		107

4. Notes.

- a. Note A: Provide two hinges for all doors up to five feet high. Provide one additional leaf for each 30 inches in height, or fraction thereof. The hinge size shall be 4.5 x 4.5 on standard weight and 4.5 x 4.5 on heavy weight, unless noted.
- b. Note 1: Provide power transfer CEPT-10 by Securitron.

B. Active Leaf Locking Devices (100)

1. The locking functions shall be the type as listed.

2. Catalog reference.

- a. Von Duprin. (Items 101, 102, 108, 109.)
- b. Best. (Items 103 to 105, 107, 110.)
- c. Adams Rite (Item 106.)
- c. CR Laurence. (Items 111.)

3. Item description.

a.	101 – Exit Device SD-EL9827NL-OP x LBR	Note 1, 5	613
b.	102 – Exit Device SD-EL9827EO	Note 5	613

c.	103 – Mortise Lock-set 45H7D87H		613
d.	104 – Mortise Lock-set 45HA87H		613
e.	105 – Mortise Lock-set 45H0LT87H	Note 2	613
f.	106 – Deadlock MS1852S – 415/416	Note 3	613
g.	107 – Mortise Lock-set 45H7TD87H	Note 4	613
h.	108 – Exit Device CD9827NL-OP x LBR	Note 5	613
i.	109 – Exit Device CD9827EO x LBR	Note 5	613
j.	110 – Mortise Latch-set 45HON87H		613
k.	111 – Door Pull with Deadbolt DB140K-S	Note 6, 7	613

4. Notes.

- a. Note A: The trim for all lock/latch-sets and all exit devices shall be as indicated.
- b. Note 1: Provide power supply PS914-2RS.
- c. Note 2: Provide 7200ER-1 emergency coin release with occupancy indicator.
- d. Note 3: Include strike 4001-011 and threshold bolt 4015.
- e. Note 4: Provide 7/8" lip to center strike.
- f. Note 5: Locate the centerline 2-3/16" from the edge of the door.
- g. Note 6: Provide key cylinder outside and turn cylinder inside.
- h. Note 7: Provide two floor strikes AMR209PS, 1 @ 0° and 1 @ 90°. The 90° location acts as a hold open.

C. Inactive Leaf-Locking Devices (200)

- 1. Furnish the type as listed.
- 2. Catalog reference.

a. Trimco. (Item 201.)

3. Item description.

a.	201 – Manual Flush Bolts 3917	Note 1, 2	613

4. Notes.

a.	Note 1:	Locate the top bolt at 72" and the bottom bolt at 12".
b.	Note 2:	Provide 3910N-630 floor strike set in epoxy.

D. Door Control Devices (300)

1. Furnish the type as listed.

2. Catalog reference.

a.	Trimco.	(Items 301, 302, 304, 306.)
b.	ABH.	(Items 303, 305.)

3. Item description.

a.	301 – Floor Stop 1231	613
b.	302 – Wall Stop 1278CX	613
c.	303 – Overhead Concealed Stop 4024 – 90°	613
d.	304 – Wall Stop 1278CX	Note 1 613
e.	305 – Overhead Holder 8010	695
f.	306 – Floor Stop 7281	613

4. Notes.

a.	Note A:	Degree of door swing shall be up to 180 degrees or as controlled by hardware specified or partition layout.
b.	Note 1:	Mount the stop on the edge of the partition.

E. Door Closing Devices (400)

1. Furnish the type as listed.

2. Catalog reference.

- a. LCN. (Items 401 to 405.)
- b. Dorma. (Items 406.)

3. Item description.

a.	401 – Dual Automatic Header 2852	Note 1, 2	SPL
b.	402 – Surface Closer 4011-DEL x ST-1544		695
c.	403 – Surface Closer 4011-DEL		695
d.	404 – Dual Dummy Header 2852 x MP x MP	Note 3	SPL
e.	405 – Surface Closer 4111 x SHCUSH		695
f.	406 – Floor Closer BTS80		613

4. Notes.

- a. Note A: Coordinate all templates of closers with the hanging device pivot point. Supply special templates as required.
- b. Note 1: Provide one Wikk switch SFA-3 for Item 401. One is located outside on the bollard and one on the inside on the bollard. Include sequence option Part Number 8310-845 (function 65).
- c. Note 2: Provide key switch with MK cylinder to control the outside operating switch, locate on the inside bollard.
- d. Note 3: Provide two 2014 manual closers.

F. Push Units (500)

1. Furnish type as listed.

2. Catalog reference.

- a. Von Duprin. (Item 501.)
- b. Rockwood. (Item 502.)

3. Item description.

- a. 501 – Push Bar 350 613
- b. 502 – Push Bar x 6HD Note 1 613
- 4. Notes.
 - a. Note 1: Provide a push bar that matches Item 601.

G. Pull Units (600)

- 1. Furnish type as listed.
- 2. Catalog reference.
 - a. Rockwood. (Item 601.)
- 3. Item description.
 - a. 601 – Door Pull RM3701-36" x 12HD 613
- 4. Notes.
 - a. Not required.

H. Door Protection Plates (700)

- 1. Furnish the type as listed.
- 2. Catalog reference.
 - a. Trimco. (Items 701 to 703.)
- 3. Item description.
 - a. 701 – Kick Plate K0050 10"H x W.O.D. – 1.5 inches x B4E 613
 - b. 702 – Kick Plate K0050 10"H x W.O.D. – 1.0 inches x B4E 613
- 4. Note
 - a. Not required.

I. Miscellaneous Equipment (800)

1. Furnish type as listed.
2. Catalog reference.
 - a. Trimco. (Item 801.)
3. Item description.
 - a. 801 – Silencer 1229B Note 1 STD
4. Notes.
 - a. Note 1: Provide 3 per single frame and 2 per pair frame.

J. Thresholds and Seals (900)

1. Furnish type as listed.
2. Catalog reference.
 - a. National Guard. (Items 901, 903, 905.)
 - b. Zero. (Items 902, 906, 907.)
3. Item description.
 - a. 901 – Weather-stripping for head and jamb 5050C
STD
 - b. 902 – Threshold – See detail 4A/A5.3 BRZ
 - c. 903 – Exterior Bottom Sweeps 673DKB (each leaf of pair) STD
 - d. 904 – Interior Bottom Sweeps by Hope. SPL
 - e. 905 – Split Astragal 172DKB (2) STD
 - f. 906 – Threshold 65B STD
 - g. 907 – Astragal 383D STD
4. Notes.

- a. Note A: Install thresholds with 1/4-20 brass machine screws and anchors.

2.3 HARDWARE FINISHES

- A. All hardware shall be supplied in the BHMA finish indicated.
- B. The symbol STD indicates that the manufacturers' standard finish is to be supplied.
- C. The symbol SPL indicates that the item is to be finished to match the door and frame color.

2.4 HARDWARE GROUPS

- A. Each group is identified in the door schedule with a group number.
- B. Each group shall include sufficient quantity of each item to complete the opening.
- C. Each group is comprised of various items as indicated below.

Hardware Group	Hanging Device	Active Leaf Locking Devices	Inactive Leaf Locking Devices	Door Control Devices	Door Closing Devices	Push Units	Pull Units	Door Protection Plates	Miscellaneous Equipment	Thresholds and Door Seals
GRP	000	100	200	300	400	500	600	700	800	900
01	001 001	101 102			401		601 601			901 902 903 904 905
02	002 002			301 301	401	501 501	601 601			901
03	003	103		302					801	
04	003	104		302					801	
05	004	105		303	402			701	801	
06	004	105		304	403			701	801	

Hardware Group	Hanging Device	Active Leaf Locking Devices	Inactive Leaf Locking Devices	Door Control Devices	Door Closing Devices	Push Units	Pull Units	Door Protection Plates	Miscellaneous Equipment	Thresholds and Door Seals
GRP	000	100	200	300	400	500	600	700	800	900
07	005 005	106			404	502 502	601 601			901 902 903 904 905
08	006 006	107	201	305	405			702 702		901 903 906 907
09	005 005	108 109			404					901 902 903 904 905
10	005	103			405			701		901 903 906
11	007	110			403			701		
12	007	103			405			701		
13		111		306	406					
14	ALL HARDWARE REMAINS EXCEPT THE LOCK-SET. IT IS TO BE RELACED WITH A MATCHING LOCKSET EXCEPT IN 613 (US10B) FINISH.									

2.5 SPECIAL INSTRUCTIONS

- A. Acceptable substitutions to be determined.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Factory or shop prepare all work for installation of hardware.

3.2 INSTALLATION

- A. Follow hardware manufacturer's instructions and recommendations.
- B. Install surface-mounted items after substrates have been completely finished; install recessed items and recessed portions of items before finishes are applied and provide suitable, effective protection.
 - 1. When surface-mounted items are installed before final finish; remove, store, and reinstall, or apply suitable effective protection.
- C. Mount at heights that are indicated by the Architect on the detail drawings;
 - 1. Exception(s):
 - a. As required to comply with applicable regulations.
 - b. As indicated on the drawings for specific hardware items.
- D. Set units level, plumb and true to line and location.
- E. Reinforce substrates as necessary for proper installation and operation.

3.3 ADJUSTMENT

- A. Adjust each operating item of hardware and each door for proper operation and function; replace units which cannot be adjusted to operate freely and smoothly.
- B. Adjust door closers to compensate for operation of heating and ventilating systems after systems have been balanced.
- C. Wherever hardware installation is made more than one month prior to completion or occupancy; restore to proper operation.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Instruct the owner's personnel in the operation and maintenance of hardware and hardware finishes.

3.5 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation.

END OF SECTION 087100

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Steel and glass door assemblies.
 - 2. All glass entrances.
 - 3. Steel windows.
- B. Related Requirements:
 - 1. Section 08 11 00 "Steel and Glass Doors."
 - 2. Section 08 41 26 "All-Glass Entrances."
 - 3. Section 08 51 23 "Steel Windows."

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each glass product and glazing material indicated.
- B. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish samples of the following:
 - 1. Except for clear glass, submit samples of each glass type specified, in the form of **12 inch** square Samples.
- C. Shop Drawings: Include plans, elevations, and sections. Show fabrication and installation details. Include the following:
 - 1. Location of glass panels.

2. Size, thickness and edge profiles of glass materials.
 3. Full-size details of glazing methods, mounting and attachment to other work.
 4. Delegated-Design: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Glazing Schedule: Use same designations indicated on Drawings for glass types in preparing a schedule listing glass types and thicknesses for each.
1. Glazing Schedule may be submitted as part of Shop Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that he has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.
- B. Design Data: Submit the following from the glass manufacturer:
1. Wind Load Analysis: For each glass unit type, each building elevation. Submit analysis that clearly demonstrates indicate that the statistical probability of breakage at the design wind pressure will not exceed the specified statistical probability of breakage.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit data for each type of glass suitable to include in maintenance manuals.
- B. Warranties: Submit special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Glass and Glazing Accessories: Obtain glass and glazing accessories from one source for each product indicated below:
1. Primary glass.
 2. Coated glass.
 3. Heat-treated glass.
 4. Insulating glass.
 5. Glazing gaskets.

- C. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1.
1. Building Subcode: Comply with Table 2406.2(1), "Minimum Category Classification of Glazing," in ICC's International Building Code 2009/New Jersey Edition.
 2. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch up and 3/4-inch over.
- D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Glazing Manual."
 2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines."
- E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council (IGCC) or of the Associated Laboratories, Inc. (ALI).
- F. Quality Control (Production) Testing: As a minimum, provide the following quality control (production) testing for the exterior glass units:
1. Bow and Warp Distortion (Flatness) Tolerance Testing:
 - a. During the production of the heat-treated glass lites, measure for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.
 - 1) Measure the monolithic glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.
 - b. During glass production, and once an hour, randomly select a single heat-treated glass lite and measure it. Document and record results. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites were not incorporated into the Work.
 - c. Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each tested glass lite to the Owner and Architect, if

requested. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:
 - a. During the production of the heat-treated glass lites, measure each low emissivity coated, unfritted, monolithic glass lite having a 1/4-inch thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices. During the production of the 100 percent full screen, frit-coated monolithic heat-treated glass lites having a 1/4-inch thickness or greater, and at a frequency of at least once an hour, randomly select a monolithic single lite and measure it using a trolley type scanning measurement device complying with ASTM C 1651.
 - 1) Measure the monolithic glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.
 - b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites were not incorporated into the Work.
 - 1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.
3. Insulating Glass Unit Testing Requirements: During production, test insulating glass units as follows:
 - a. Butterfly Unit Adhesion Pull Testing:
 - 1) Adhesion Criteria: Comply with the pass/fail requirements of the sealant manufacturer's published guidelines and/or sealant manufacturer's certification audit requirements/recommendations. Minimum pull back to 30 degrees from horizontal with no adhesive failure.
 - 2) Frequency: Test one minimum 24-by-36-inch size unit each eight-hour shift and after each sealant drum change.
 - 3) Test units shall be fabricated on the same production line and processing equipment and with the same spacers and sealant used in the production of the insulating glass units fabricated for the Project.
 - b. Desiccant Temperature Rise Testing:
 - 1) Test Criteria: Comply with the desiccant manufacturer's written recommendations.
 - 2) Frequency: Test a minimum of once every eight-hour shift and after each drum change.

- c. Bow/Warp and Air Space Measurement Concave/Convex Testing:
 - 1) Measure and record bow and warp once every hour on a vertical plane with an aluminum straight edge or with a laser.
 - 2) Measure and record unit center air space a minimum of once an hour with a checking gage (FDR Designs, or equal) and visually inspect all units.
- d. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary/secondary seal interface shall be 1 inch in length and 3/32 inch in width.
- e. Document and record results. Provide additional documentation upon request by the Owner or Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting (using either breather or capillary tubes) and sealing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with glazing by field measurements before fabrication and indicate measurements on Glazing Schedule.

1.9 WARRANTY

- A. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units whose hermetic seal has failed within specified warranty period indicated below. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass. Upon notification of such deterioration within the warranty period, furnish replacement glass units for failed glass units at the convenience of the Owner.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Coated Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements

for those coated-glass units whose coatings flake, peel, or crack within the specified warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units whose coatings have flaked, peeled, cracked or deteriorated at the convenience of the Owner.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Provide and install watertight and airtight glazing systems capable of withstanding thermal movement and wind and impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.
- B. Delegated Glass Design: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing and glazing details. Confirm glass thicknesses and heat treatments, verified by analysis, as required to meet the performance and testing requirements specified in individual product sections for glazing assemblies, Project loads and in-service conditions.
 1. Glass Thicknesses for Exterior Glazing: Design glass including comprehensive engineering analysis by a qualified professional engineer to determine minimum glass thicknesses to comply with the Building Subcode and ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: Determine design wind loads applicable to Project based upon design wind speed, exposure category, occupancy category, and heights above grade indicated on Drawings, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures":
 - 1) Basic Wind Speed: 95 miles per hour.
 - 2) Exposure Category: B.
 - 3) Occupancy Category: II.
 - b. Probability of Breakage for Vertical or Sloped Glazing: Not greater than 5 lites per 1000.
 - 1) Load Duration: 60 seconds or less.
 - c. Maximum Lateral Deflection: For glass supported on all 4 edges, provide thickness required that limits center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch, whichever is less.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm, except as otherwise noted.
 2. Glass Thicknesses for Interior Glazing: Select minimum glass thicknesses to comply with published recommendations of glass product manufacturers and referenced glazing publications.

- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide insulating glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2 inch wide interspace.
 2. Center-of-Glass U-Values: NFRC 100 methodology using LBL WINDOW 6.3 computer program, expressed as Btu/ sq. ft. x h x deg F.
 3. Solar Heat Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL WINDOW 6.3 computer program.
 4. Visible Reflectance (Solar Optical) Properties: Center-of-glazing values, according to NFRC 300.

2.2 GLASS TYPES

- A. General: Refer to Drawings for locations and extent of glass types.
- B. Glass Type I-1: Solar-Control, Low-E, Insulating-Glass Units.
1. Basis of Design: "Solarban 60 (2) Clear + Clear"; PPG Industries, Inc.
 2. Overall Unit Thickness: 25 mm.
 3. Interspace Content: Air.
 4. Outdoor Lite: Class 1 (clear) float glass.
 - a. Kind HS (heat strengthened), in non-hazardous glazing applications.
 - b. Kind FT (fully tempered), in hazardous glazing applications.
 - c. Thickness: 6.0 mm, minimum.
 - d. Low-E Coating: Vacuum-deposited sputter-coating on second surface.
 5. Indoor Lite: Class 1 (clear) float glass.
 - a. Kind HS (heat strengthened), in non-hazardous glazing applications.
 - b. Kind FT (fully tempered), in hazardous glazing applications.
 - c. Thickness: 6.0 mm, minimum.
 6. Visible Light Transmittance: 70 percent.
 7. Visible Light Reflectance: 11 percent.
 8. Solar Heat Gain Coefficient: 0.38 maximum.
 9. Shading Coefficient: 0.44 maximum.
 10. Winter Nighttime U-Factor: 0.29 maximum.
 11. Summer Daytime U-Factor: 0.27 maximum.
 12. Application: Vision panels for exterior glazing.
 13. Glass Panel Sizes: Comply with requirements indicated on Drawings.

- C. Glass Type S-1: Single Monolithic Clear Float-Glass Units.
 - 1. Thickness: 6.0 mm.
 - 2. Heat Treatment: Kind FT (fully tempered) float glass.
 - 3. Application: Vision panels for interior glazing.
 - 4. Glass Panel Sizes: Comply with requirements indicated on Drawings.
- D. Glass Type S-2: Single Monolithic Clear Float-Glass Units.
 - 1. Thickness: 16.0 mm.
 - 2. Heat Treatment: Kind FT (fully tempered) float glass.
 - 3. Application: All glass entrance assemblies.
 - 4. Glass Panel Sizes: Comply with requirements indicated on Drawings.

2.3 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select), Class 1, (clear), as indicated in schedules.
 - 1. In order to reduce the possibility of glass color range rejection, the supplier of float (primary) glass products shall provide glass for the entire Project from a single facility using stockpiled batch run materials from a single source for the entire Project.
 - 2. Float Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1036, all glass shall be supplied meeting the following quality standards:
 - a. Point blemishes - seeds/stones with distortion, stain spots, dirt, surface damage - shall be limited to 0.060 inch maximum separated by 12 inches minimum.
 - b. Glass scratch/rubs shall be rejected if detectable at 10 feet.
 - c. Water blow-off stains, tag residue, and handprints will not be permitted.

2.4 HEAT-TREATED FLOAT GLASS

- A. General: Heat-treat glass where the need is determined by thermal stress analyses, by wind load analyses, and where required to meet safety glazing requirements.
 - 1. Provide Kind FT (fully tempered) float glass for all safety glazing applications or hazardous condition locations, except as otherwise indicated.
 - 2. Provide Kind HS (heat-strengthened) float glass wherever fully tempered float glass is not required, except as otherwise indicated.
- B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit.
- C. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field.

- D. Heat-Strengthened Glass: Provide glass complying with ASTM C 1048 Kind HS. Surface compression range shall be between 4,000 psi and 7,000 psi for 1/4 inch thick glass.
1. Heat-Strengthened Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:
 - a. Chill cracks, roller marks, and picture framing shall not be permitted.
 - b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.
- E. Fully Tempered Glass: Provide glass complying with ASTM C 1048 Kind FT and meeting the requirements of ANSI Z97.1. Surface compression shall be equal to or greater than 10,000 psi.
1. Tempered Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:
 - a. Chill cracks, roller marks, and picture framing shall not be permitted.
 - b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.
- F. Flatness Tolerances: All heat-treated glass shall be fabricated to the following flatness tolerances. Verification of compliance for overall bow and warp shall be in accordance with ASTM C 1048. Verification of compliance for flatness shall be via an optical scanning device such as LiteSentry or Osprey Series.
1. Overall Bow and Warp: Not greater than the maximum bow and warp tolerances in any direction as listed in ASTM C 1048 Table 2. Localized warp limited to 1/32 inch in 12 inches.
 2. Roll Ripple: The deviation from flatness at any peak (peak to valley deviation) shall not exceed 0.003 inches for 6 mm thick glass in the glass center, with leading and trailing edge deviation not to exceed 0.008 inches for 6 mm thick glass.
- G. Millidiopter Criteria: Maximum +/- 120 millidiopeters overall or the highest overall measurement from the approved visual mockup that is less than +/- 120 millidiopter overall whichever is less when viewed outdoors.

2.5 COATED FLOAT GLASS

- A. General: Provide coated glass complying with requirements indicated in this Article, under Paragraph "Insulating Glass," and in schedules.
1. Sputter-Coated Float Glass: Float glass with the coating(s) specified in schedules, deposited by magnetron sputtered vacuum deposition process after manufacture and heat treatment (if any). Pyrolytic and wet chemical deposition glass coatings will not be permitted.
 2. Coating Quality: The allowable range of defects in coatings applied to glass shall be as accepted through glass sample submissions. Installed coated glass products which are outside of the accepted sample range shall be subject to rejection by the Architect. In order to reduce the possibility of glass rejection, the supplier of coated glass products shall provide glass coating production runs for the entire

Project from a single coating facility. All coated glass shall be provided from a single coating facility. The allowable range of defects are defined as follows:

- a. The vision glass area is defined as the field of glass which is greater than 1 inch from the glass unit edge.
 - 1) Pinholes: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings:
 - a) Pinholes greater than 1/16 inch in diameter shall not be permitted in 80 percent of the central portion of the vision glass area and separated by greater than or equal to 12 inches. Pinholes larger than 3/32 inch are not allowed in the outer 20 percent of the perimeter vision glass area and separated by greater than or equal to 12 inches;
 - b) No more than two readily apparent blemishes are allowed in a 3 inch diameter circle and no more than five readily apparent blemishes are allowed in a 12 inch diameter circle.
 - 2) Scratches: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings, and 15 feet for reflective coatings:
 - a) Scratches are allowed in 80 percent of the central glass area if not detectable at the viewing distance, and scratches less than or equal to 1 inch are allowed in the outer 20 percent area if not detectable at the viewing distance. Concentrated scratches or abraded areas are not allowed.
 - b) Scuffs, rub marks, cup marks, or abraded areas shall not be permitted in any glass area.
 - 3) Reflectance and Transmission Inspection: When viewed outdoors against a bright uniform opaque background at a distance of 10 feet for low emissivity coatings, color, reflectance and transmission will be permitted to have a slight variance subject to Architect's acceptance.
 - a) Mottling and streaking of the coating shall not be permitted.
 - b) Coating arcing will not be permitted.
 - c) Water blow-off stains will not be permitted.
 - d) Handprints will not be permitted.
 - e) Roller marks shall not be permitted.
 - f) Positive and negative air distortion shall not be permitted.
 - g) Tag residue shall not be permitted.

2.6 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 1. AFG Industries, Inc.
 2. JE Berkowitz, LP.

3. Cardinal Glass Industries.
4. Guardian Industries Corporation.
5. Oldcastle Glass, Inc.
6. Pilkington North America.
7. PPG Industries, Inc.
8. Viracon, Inc.

B. Insulating-Glass Units: Preassembled units, with dehydrated entrapped air, consisting of sheets of glass hermetically sealed at all edges with a polyisobutylene primary and a black silicone secondary elastomeric sealant. The lites of glass shall be separated by dessicant containing mill finished aluminum spacers. All insulating glass units shall be IGCC certified to comply with ASTM E 2190 and with requirements specified in this Article and in the Glass Schedule.

1. Provide Kind HS (heat-strengthened) float glass where needed to comply with "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

C. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Glass Schedule are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

2.7 GLAZING FILMS

- A. PVC Film Overlay: Translucent, dimensionally stable cast PVC film, 2-mil (0.05-mm) minimum thickness, with pressure-sensitive clear, adhesive back for adhering to glass substrates indicated and releasable protective backing.

2.8 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Sealant shall have a VOC content of 250 g/L or less.
- B. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

2.9 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.10 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
- B. Dense Compression Gaskets:
 1. Neoprene: Continuous extruded neoprene with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.
 2. EPDM: Continuous extruded EPDM with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 864, Option II. Provide injection molded corners.
 3. Silicone: Continuous extruded silicone with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115, Type C. Provide injection molded corners.
 4. Thermoplastic Polyolefin Rubber: Continuous extruded thermoplastic polyolefin rubber with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115. Provide injection molded corners.
 5. Any material indicated above.
- C. Soft Compression Gaskets: Continuous extruded expanded foam with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 509, Option II, Type II; provide the following:
 1. Neoprene.
 2. EPDM.
 3. Silicone.
 4. Thermoplastic polyolefin rubber.
 5. Any material indicated above.

2.11 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for

application indicated, and with a proven record of compatibility with surfaces, and wet glazing materials, contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM complying with ASTM C 864 (Option II), blocks, 85 +/- 5 Shore A durometer hardness, **1/16 inch** less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than **4 inches**.
2. Silicone complying with ASTM C 1115 (Type C), blocks, 85 +/- 5 Shore A durometer hardness, **1/16 inch** less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than **4 inches**.

D. Edge Blocks:

1. Silicone complying with ASTM C 1115 (Type C), blocks, 65 +/- 5 Shore A durometer hardness, minimum **4 inches** long and sized to allow **1/8 inch** clearance between edge of glass and block.
2. EPDM complying with ASTM C 864 (Option II), blocks, 65 +/- 5 Shore A durometer hardness, minimum **4 inches** long and sized to allow **1/8 inch** clearance between edge of glass and block.

E. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2.12 HARDWARE COMPONENTS

A. Hardware: Comply with requirements indicated on Drawings for profiles, configuration and arrangement of components.

1. Material and Finish: Fabricate hardware components from Type 304 stainless steel.
2. Manufacturer: Subject to compliance with requirements, provide products manufactured by one of the following:

- a. CHMI Custom Hardware Manufacturing, Inc.
- b. Laurence, C. R. Co., Inc.

B. Fasteners, Anchors and Inserts: Provide stainless steel fasteners and devices as required for hardware installation.

2.13 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

1. Edge and Surface Conditions: Comply with the recommendations of AAMA "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.
- B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass **2 inches** larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier and glass framing erector present, for compliance with the following:
 1. Compliance with the specified manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
 1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.
- B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.
- C. Seal vent (breather or capillary) tubes in insulating glass units in accordance with the insulating glass manufacturer's written recommendations.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
 - 1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to surfaces indicated to receive glazing materials. Use primers as determined by preconstruction compatibility and adhesion testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of silicone sealant.
 - 1. For Glass Units Less Than **72 inches**: Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer.
 - 2. For Glass Units **72 inches** or Greater: Locate setting blocks at sill one-eighth of the width in from each end of the glass, but not less than **6 inches**, unless otherwise recommended by the glass manufacturer.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than **50 inches** as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide **1/8 inch** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking to prevent glass lites from moving sideways in glazing channel, sized and located to comply with the glass manufacturer's recommendations and the requirements in referenced glazing publications.
 - 1. Edge blocking will not be required at structural glazed window and curtain walls unless specifically required by the glass manufacturer for the conditions shown.

- I. Set glass lites with uniform pattern, draw, bow, and similar characteristics, producing the greatest possible degree of uniformity in appearance on the entire exterior wall elevation.
 - 1. Set glass units with void between edge of units and glazing channel.
 - 2. Orient and install insulating glass units made up with one lite of low emissivity coated glass with the uncoated glass lite on the inboard (building) side.
 - 3. Orient and install insulating glass units made up with one lite of tinted glass with the untinted glass lite on the inboard (building) side.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Miter cut gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away and join with sealant recommended by gasket manufacturer which will provide an airtight and watertight seal at the joint.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Use special tool to install and remove filler strips; lubricate in accordance with manufacturer's instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.6 DECORATIVE FILM OVERLAY

A. Decorative Film Overlay:

1. Install products only within ambient and substrate temperature ranges recommended by manufacturer.
2. Apply film to cleaned glass substrate squarely aligned to glass edges.
3. Apply film uniformly smooth and free from tears, air bubbles, wrinkles, and rough edges.
4. Apply in single sheet completely overlaying glass substrate according to manufacturer's written instructions.

3.7 PROTECTION AND CLEANING

- A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08 80 00

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood framing members.
 - 2. Section 09 29 00 "Gypsum Board" for gypsum panel installation and finishing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver suspension-system components and accessories to Project site in original unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Gypsum Board Ceiling Assembly Deflection: Limit deflection to 1/360 of the distance between supports based on dead weight plus horizontal loading of 5 lbf/sq. ft.

2.2 SUSPENSION SYSTEMS

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories complying with applicable requirements of ASTM C 635 for designated type, structural classification, and finish indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal fabrications, unless otherwise indicated.
 2. Protective Coating: ASTM A 653, **G40**, hot-dip galvanized unless otherwise indicated.
- B. Grid Suspension System for Gypsum Board Ceilings: ASTM C 635, direct-hung system composed of main beams and cross-furring members that interlock; provide perimeter angles, ceiling transition clips, beam adapter clips, and accessories required for a complete installation.
1. Structural Classification: Heavy-duty system.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.
 - c. United States Gypsum Company; Drywall Suspension System.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
- B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- C. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, **0.062-inch** diameter wire, or double strand of **0.048-inch** diameter wire.
- D. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper.
1. Size: Select wire diameter sufficient that its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than **0.162** diameter wire.
- E. Flat Hangers: Mild steel, zinc coated.
- F. Fasteners: Provide type, material, size, recommended by suspension system manufacturer for corrosion resistance, holding power, and other properties required to fasten components to framing members.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 SUSPENSION SYSTEM INSTALLATION

- A. General: Install suspension system in accordance with manufacturer's instructions and applicable requirements of ASTM C 636.
- B. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches on center.
 - 2. Main Beams: 48 inches on center.
 - 3. Furring Members: 16 inches on center.
- C. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- D. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Attach hangers to structural members only.
 - 6. Do not support hangers directly from roof sheathing.
 - 7. Do not support hangers from ducts, pipes, or conduit.

- E. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood framing members.
 - 2. Section 09 22 16 "Non-Structural Metal Framing" for suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: Full-size exposed trim accessory Samples in 12-inch lengths for each type indicated.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 PANEL MATERIALS, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corporation.
 - 3. Georgia-Pacific Building Products.
 - 4. National Gypsum Company.
 - 5. United States Gypsum Company.

B. Gypsum Board: ASTM C 1396.

1. Type X.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.
4. Location: Typical interior partitions.

C. Gypsum Ceiling Board: ASTM C 1396.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.
3. Location: Interior ceiling assemblies.

D. Mold-Resistant Gypsum Board: ASTM C 1396; with moisture- and mold-resistant core and paper surfaces.

1. Type X.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
5. Location: Interior finish at exterior wall assemblies.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. National Gypsum Company; PermaBase BRAND Cement Board.
 - d. United States Gypsum Company; DUROCK Cement Board or USG Durock® Brand Cement Board.
2. Thickness: 1/2 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Steel Trim Accessories: ASTM C 1047; galvanized steel sheet by hot-dipped process. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047.

1. Cornerbead: Use at outside corners.
2. LC-Bead with both face and back flanges to receive joint compound; use at exposed panel edges.
3. U-Bead with face and back flanges; face flange formed to be left without application of joint compound: Use where indicated.
4. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.

- B. Aluminum Trim Accessories: Extruded accessories of profiles and dimensions indicated.
 - 1. Basis of Design: "INDEC IN 80 AE"; Schluter Systems, LP.
 - 2. Profiles and Configurations: As indicated on Drawings.
 - 3. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221**, Alloy 6063-T5.
 - 4. Finish: Clear, satin anodized finish.
- C. Miscellaneous Trim Accessories: Extruded aluminum components with **1/4 inch** diameter holes in fins for attachment to gypsum board or studs; longest lengths available in profiles indicated; primed for finish painting; sized for board thickness shown.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation.
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
 - d. Pittcon Industries.

2.6 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of the products and joint treatment materials for each application indicated.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - 3. Second Coat: For filling over tape, beads and fasteners, use setting-type, sandable topping compound.
 - 4. Third Coat: For finishing over tape, beads and fasteners, use drying-type, all-purpose compound.
- D. Joint Compound for Cementitious Backer Units: Type recommended by panel manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Provide product that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR.
 - b. United States Gypsum Company; SHEETROCK Acoustical Sealant.
 - 2. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), :

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including door frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. General: Install and finish gypsum panels to comply with ASTM C 840, GA-216, and manufacturer's recommendations.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft.** in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch** wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- I. Steel Framing or Furring: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of flanges first.
- J. Attach gypsum panels to framing provided at openings and cutouts.
- K. Cut openings in gypsum board for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges will be covered by plates and escutcheons. Cut both face and back paper. Do not install electrical outlets back to back on opposing sides of partitions.
- L. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- M. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Space fasteners in gypsum panels according to referenced gypsum panel application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches on center for vertical applications.
2. Install fasteners not less than 3/8 inch from ends or edges of gypsum board panels, spacing fasteners opposite each other on adjacent ends or edges.
3. Begin fastening from center of gypsum panel and proceed toward edges and corners.
4. Apply pressure on surface of gypsum panel adjacent to fasteners being driven to ensure that gypsum panel will be secured tightly to supporting members.
 - a. Drive fastener with shank perpendicular to face of panel.
 - b. Drive screws with a power screwdriver as recommended by gypsum panel manufacturer. Set heads of screws slightly below surface of paper without cutting paper.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive ceramic tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: Fasten trim accessories according to manufacturer's written instructions for type, length, and spacing of fasteners.
- B. Install corner beads at external corners.
- C. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.
- D. Install aluminum trim accessories where indicated.
- E. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840 and as follows:
 - 1. Where a partition, wall or ceiling traverses a construction joint (expansion, seismic or building control element) in the base building structure.
 - 2. Where a wall or a partition runs in an uninterrupted straight plane exceeding **30 linear feet**.
 - 3. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed **50 feet** and total area between control joints does not exceed **2500 square feet**.
 - 4. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed **30 linear feet** and total area between control joints does not exceed **900 square feet**.
 - 5. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

3.6 FINISHING GYPSUM BOARD

- A. General: Apply joint treatment at gypsum board joints, flanges of interior trim and aluminum trim accessories, interior angles, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for sound-rated assemblies.

2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
 3. Level 4: Embed tape and apply separate first, second, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Provide final protection and maintain conditions that ensure gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 29 00

SECTION 093013

CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Tile materials.
- 2. Setting and grouting materials.
- 3. Stone thresholds installed as part of tile installations.
- 4. Metal edge strips.

- B. Related Requirements:

- 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
- 2. Section 09 29 00 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section, unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size excluding spacer lugs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification:

1. Full-size tile samples for each type.
2. Cured samples of grout materials in 6-inch lengths for each type and color
3. Stone thresholds in 6-inch lengths.
4. Metal edge strips in 6-inch lengths.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of quantity installed for each type, composition, color, pattern, and size indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Source Limitations for Tile: Obtain tile of each type and color and finish from a single source or producer.
 1. Obtain tile of each type and color and finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from a single source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Stone thresholds.
 - 2. Metal edge strips.
- D. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
- E. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- F. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Match Architect's control samples.
- G. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- H. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

2.2 TILE PRODUCTS

- A. Basis of Design: Provide products indicated on Drawings and Interior Finish Schedule.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. American Olean; a division of Dal-Tile Corporation.
 - b. Crossville, Inc.
 - c. Daltile.
 - 2. Provide matching trim materials for project conditions indicated.
 - a. Exterior corners.
 - b. Interior corners.
 - c. Surface bullnose.

- d. Coves.
- e. Base.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
- B. Granite Thresholds: ASTM C 615, with honed finish.
 - 1. Description: Uniform, fine- to medium-grained stone without veining.
 - 2. Variety and appearance: Match Architect's control sample.
 - 3. Profile and dimensions: As indicated on Drawings.

2.4 SETTING MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Custom Building Products.
 - 2. Laticrete International, Inc.
 - 3. MAPEI Corporation.
- B. Latex Polymer Modified, Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. Acceptable types:
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - b. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- C. Latex Polymer Modified, Dry-Set Mortar (Medium-Bed): Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness indicated.
 - 1. Acceptable types:
 - a. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - b. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

2.5 GROUT MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Custom Building Products.
 - 2. Laticrete International, Inc.
 - 3. MAPEI Corporation.
- B. Latex Polymer Modified, High-Performance Tile Grout: ANSI A118.7.
 - 1. Acceptable types:
 - a. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients to which only water must be added at Project site.
 - b. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix at Project site.
 - 2. Provide sanded grout mixture for joints greater than **1/8 inch**.
 - 3. Provide unsanded grout mixture for joints 1/8 inch and narrower.
 - 4. Color: Match Architect's control sample.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3.
 - 1. VOC Content: Not more than 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge materials.
 - 1. Basis of Design: "Jolly"; Schluter Systems, LP.
 - 2. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - 3. Profiles and Configurations: As indicated on Drawings.
- C. Temporary Protective Coating: Product specifically recommended by tile manufacturer and formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. Large format floor tile: Comply with requirements and procedures in ANSI A108 Series in tile installation standards for providing 95 percent mortar coverage.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in pattern indicated on Drawings, and if not indicated, lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Provide manufacturer's standard trim shapes as indicated or where necessary to eliminate exposed tile edges.
 - 4. Install full size tile and trim to the greatest extent. Do not install cut tile or trim in less than half unit widths or lengths unless directed or specifically approved in advance by the Architect.
- E. Joint Widths: As indicated on Drawings.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- G. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as adjacent floor tile, unless otherwise indicated.
- H. Metal Edge Strips: Install at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations Over Concrete Subfloor:
 1. Ceramic Tile Installation: TCNA F113 and ANSI A108.5; thinset application.
 - a. Ceramic Tile Type: As indicated on Drawings and Interior Finish Schedule.
 - b. Thinset Mortar: Medium-bed, latex polymer modified, dry-set mortar.
 - c. Grout: Latex polymer modified, high-performance tile grout, unless otherwise indicated; ANSI A108.10.
 - d. Grout: Water-cleanable epoxy grout, where indicated; ANSI A108.6.

- B. Interior Wall Installations Over Wood Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C and ANSI A108.5; thinset application on cementitious backer units.
 - a. Ceramic Tile Type: As indicated on Drawings and Interior Finish Schedule.
 - b. Thinset Mortar: Latex polymer modified, dry-set mortar.
 - c. Grout: Latex polymer modified, high-performance tile grout; ANSI A108.10.

END OF SECTION 09 30 13

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Items penetrating finished ceiling and ceiling-mounted items, including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.

- f. Access panels.
 - g. Perimeter and special moldings.
- 6. Minimum Drawing Scale: 1/2 inch = 1 foot.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 3 percent of quantity for each type installed, but not less than 2 panels.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 3 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations:

1. Acoustical Ceiling Panels: Obtain each type through one source from a single manufacturer.
2. Suspension Systems, Edge Moldings and Trim: Obtain each type through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Provide acoustical panel ceilings with fire performance indicated; testing by a qualified testing agency in accordance with ASTM E 84. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A, 25 or less, according to ASTM E 1264.
 2. Smoke-Developed Index: 450 or less.
- B. Seismic Performance: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 1. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings-- Seismic Zones 0-2."

2.3 ACOUSTICAL PANELS

- A. Basis of Design: Provide the following products indicated on Drawings and Interior Finish Schedule.
 1. APC-1: "Optima Tegular / Item 3256"; Armstrong World Industries, Inc.
 - a. Modular Size: 48 by 48 inches.
 2. APC-2: "Optima Tegular / Item 3251"; Armstrong World Industries, Inc.
 - a. Modular Size: 24 by 24 inches.
 3. APC-3: "Optima Tegular / 3261"; Armstrong World Industries, Inc.
 - a. Modular Size: 24 by 72 inches.
 4. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. CertainTeed Corporation.
 - b. United States Gypsum Company.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, light reflectance, and other properties indicated.
 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.

2. Pattern: E (lightly textured).
3. Color: White.
4. Light Reflectance (LR): Not less than 0.90.
5. Articulation Class (AC): Not less than 190.
6. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
7. Thickness: 1 inch.

- C. Antimicrobial Treatment: Provide acoustical panels treated with manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories complying with applicable requirements of ASTM C 635 for designated type, structural classification, and finish indicated.
- B. Basis of Design: "Suprafine XL 9/16" Exposed Tee; Armstrong World Industries, Inc.
1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. CertainTeed Corporation.
 - b. Chicago Metallic Corporation.
 - c. United States Gypsum Company.
- C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 3. Face Design: Flat, flush.
 4. Cap Material: Cold-rolled steel or aluminum.
 5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Chicago Metallic Corporation.
 4. United States Gypsum Company.

- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for ceiling edges and penetrations; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal between flange at exposed suspension member and partition face, soffit or adjacent gypsum board ceiling.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with the following requirements:
 - 1. Basis of design: "Axiom Perimeter Trim"; Armstrong World Industries, Inc.
 - a. Profiles and dimensional requirements: As indicated on Drawings.
 - 2. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with **ASTM B 221** for alloy and temper 6063-T5.
 - 3. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 - 4. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of **0.8 to 1.2 mils**.

2.6 ACCESSORIES

- A. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter sufficient that its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than **0.106-inch** diameter wire.
- C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings according to ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size

- supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat hangers to structure at locations indicated by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. When framing does not permit installation of hanger wires at spacing required, install supplemental support for attachment of hanger wires.
 7. Attach hangers to structural members only.
 8. Do not support hangers directly from roof sheathing.
 9. Do not support hangers from ducts, pipes, or conduit.
 10. Space hangers not more than **48 inches** on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than **8 inches** from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of 4 tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to roof sheathing.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than **16 inches** on center and not more than **3 inches** from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 096400
WOOD FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes factory-finished, engineered wood plank flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, sections, details, expansion provisions and attachments to other work.
- C. Samples for Verification: Submit 12-inch long flooring samples of same material and thickness indicated for the Work.
 - 1. Include sample sets showing the full range of normal color and texture variations expected in flooring.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wood Flooring: Equal to 2 percent of quantity installed.
 - 2. Minimum lengths: 6 feet long sections.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is acceptable to wood flooring manufacturer to install manufacturer's products or one with not less than five years experience, who has completed wood flooring similar in material, design, and extent to that indicated for this Project and whose work has resulted in wood flooring installations with a record of successful in-service performance.

- B. Source Limitations: For each type of flooring, obtain each species, grade, and cut from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with flooring manufacturer's recommendations and written instructions.
- B. Deliver wood flooring materials in unopened cartons or bundles.
- C. Protect wood flooring from exposure to moisture. Do not deliver flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
- D. Store flooring materials in a dry, warm, ventilated, weathertight location.

1.7 PROJECT CONDITIONS

- A. Conditioning period begins not less than seven days before flooring installation, is continuous through installation, and continues not less than seven days after flooring installation.
 - 1. Environmental Conditioning: Maintain an ambient temperature between **65 and 75 degrees F** and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
 - 2. Flooring Conditioning: Move flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
 - a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
 - b. Open sealed packages to allow flooring materials to acclimatize immediately on moving flooring into spaces in which it will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 ENGINEERD HARDWOOD FLOORING

- A. Engineered-Wood Plank Flooring: HPVA EF; provide flooring products that do not contain urea formaldehyde, including bonding agents and adhesives.
 - 1. Basis of Design: "Engineered Plank Flooring"; Vermont Plank Flooring.
 - 2. Wood Species and Cut: Walnut, quarter sawn.

3. Grade: Select.
4. Construction: 10-ply; 4.5 mm wear layer atop 9-ply Baltic Birch substrate.
5. Thickness: 5/8 inch.
6. Face Width: As indicated on Drawings.
7. Lengths: Maximum lengths available.
8. Edge condition: Tongue and groove with matching end grain construction.
9. Ends: Square.
10. Finish: Factory-applied transparent finish; UV-resistant.
11. Color and Appearance: Match Architect's control sample.

B. Trim: In same species, grade and finish as flooring, unless otherwise indicated.

1. Profiles and dimensions: As indicated on Drawings.

2.2 WOOD SUBFLOORING/UNDERLAYMENT

A. General: Comply with requirements of DOC PS 1 and APA - The Engineered Wood Association.

B. Plywood Subflooring: APA rated sheathing or APA rated underlayment; Exposure 1.

1. Nominal Thickness: Not less than 3/4 inch.
2. Factory mark panels to indicate compliance with applicable standard.

C. Fasteners: Provide fasteners of size and type indicated that comply with requirements for material and manufacture.

1. Nails, Brads, and Staples: ASTM F 1667.
2. Power-Driven Fasteners: NES NER-272.

2.3 ACCESSORY MATERIALS

A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils thick.

B. Asphalt-Saturated Felt: ASTM D 4869, Type II.

C. Wood Flooring Adhesive: Type recommended by flooring and adhesive manufacturers for application indicated.

1. VOC Content Limits: Adhesive shall have a VOC content of not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

E. Wood Flooring Fasteners: Type and size recommended by flooring manufacturer for project application and conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
 - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Concrete Substrates: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to flooring manufacturer's written instructions and applicable recommendations in National Wood Flooring Association (NWFA) "Hardwood Flooring Installation Guidelines."
 - 1. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 2. Concrete Moisture Testing: Perform anhydrous calcium chloride test per ASTM F 1869, as follows:
 - a. Perform tests so that each test area does not exceed 200 square feet, and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - b. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - c. Perform additional tests, if recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

- A. Concrete Substrates: Grind high spots and fill low spots to produce a maximum 1/8-inch deviation in any direction when checked with a 12-foot straight edge.
 - 1. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- B. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Comply with the following unless project conditions require more stringent requirements for performance of the work:
 - 1. Flooring manufacturer's written installation instructions.
 - 2. National Wood Flooring Association (NWFA) "Hardwood Flooring Installation Guidelines."
 - 3. Approved shop drawings.
- B. Vapor Retarder: Prior to subflooring installation, install a layer of polyethylene sheet according to flooring manufacturer's written instructions and referenced installation standards.
- C. Wood Subflooring/Underlayment:
 - 1. General: Comply with applicable recommendations in APA Form No. E30U, "Engineered Wood Construction Guide," for types of panels and applications indicated.
 - 2. Do not use materials with defects that impair quality of panels or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
 - 3. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
 - 4. Securely attach to substrate by fastening.
 - 5. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
 - 6. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
 - 7. Fasten panels to substrates indicated.
 - 8. Space panels **1/8 inch** apart at edges and ends.
- D. Asphalt-Saturated Felt: Where wood flooring is nailed or is laid to float atop wood subflooring or underlayment, install flooring over a layer of asphalt-saturated felt.
- E. Engineered Hardwood Flooring Installation:
 - 1. Follow flooring manufacturer's directions for floating installation method.
 - 2. Install flooring in pattern or direction indicated.
- F. Provide expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings.
- G. Trim: Secure trim to substrates indicated; do not nail to flooring.
- H. Touch up damage to factory-applied finishes in accordance with coating manufacturer's recommendations.

3.4 PROTECTION

- A. Protect installed flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
 - 1. Do not move heavy and sharp objects directly over kraft-paper-covered flooring. Protect flooring with plywood or hardboard panels to prevent damage from moving objects over flooring.

END OF SECTION 09 64 00

SECTION 096513

RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product requiring color selection.
- C. Samples for Verification: Manufacturer's standard-size Samples, but not less than 12 inches long, for each resilient product required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resilient products to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for each type, color, pattern, and size of resilient product installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F or more than 85 degrees F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 degrees F** or more than **85 degrees F**, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 degrees F** or more than **85 degrees F**.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE

- A. Basis of Design: Provide products indicated on Drawings and Interior Finish Schedule.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - b. Flexco.
- B. Rubber Base Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style A, Straight (Toeless): Provide in carpet areas.
 - b. Style B, Cove (with Tope-Set Toe): Provide in areas with resilient flooring and where indicated.
- C. Minimum Thickness: **0.125 inch**.
- D. Height: As indicated on Drawings and Interior Finish Schedule.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.

2.2 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 2. Johnsonite.
 - 3. Roppe Corporation, USA.
- B. Description: Rubber.
- C. Profile and Dimensions: As indicated on Drawings and Interior Finish Schedules for the following:
 - 1. Cap for cove carpet.
 - 2. Carpet edge for glue-down applications.
 - 3. Reducer strip for resilient flooring.
 - 4. Joiner for tile and carpet.
- D. Colors: As selected by Architect from manufacturer's full range of colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 - 1. VOC Content Limits: Comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Wall Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible with minimum 2 feet returns. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible with minimum 2 feet returns. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.

- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F or more than 90 degrees F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 degrees F** or more than **90 degree F**, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 degrees F** or more than **95 degrees F**.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Basis of Design: Provide products indicated on Drawings and Interior Finish Schedule.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. Armstrong World Industries, Inc.
 - b. Tarkett.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Thickness: **0.125 inch**.
- D. Size: **12 by 12 inches**.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT Adhesives: Not more than 50 g/L.
- C. Floor Polish: Protective, liquid floor-polish recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, maximum moisture content, and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare concrete substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Apply primer to concrete slabs, if recommended by the floor tile manufacturer, prior to application of adhesive.
- F. Move resilient floor tile and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 1. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
- G. Sweep and vacuum clean substrates to be covered by resilient floor tile immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis, unless otherwise indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, door frames, threshold, and edgings. Extend unexposed edges of flooring under bases and similar trim work.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings, unless otherwise indicated.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - 4. Do not wash or apply floor polishes until flooring adhesives have cured, unless otherwise recommended by the floor tile manufacturer.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply polish using methods recommended in writing by the floor polish manufacturer. Apply no fewer than 2 coats of floor polish unless additional coats are recommended by the floor polish manufacturer for the application indicated.
- E. Cover floor tile until Substantial Completion.
 - 1. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved.

END OF SECTION 096519

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Modular carpet tile.
 - 2. Installation accessories.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Type, color, and location of edge, transition, and other accessory strips.
 - 8. Transition details to other flooring materials.
- C. Samples for Verification: Full-size tile sample for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- B. Warranty: Special warranty specified in this Section.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of quantity installed for each type indicated.

1.6 QUALITY ASSURANCE

- A. Product and Installation Standards: Comply with the following publications of the Carpet and Rug Institute (CRI):
 - 1. "The Carpet Specifiers' Handbook."
 - 2. "CRI 2011 Carpet Installation Standard."
 - 3. "Green Label Plus" Standards.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard," Section 5, "Storage and Handling."

1.8 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard," Section 7, "Site Conditions" and Section 11, "Ventilation" for temperature, humidity, and ventilation limitations.

- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.9 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. Edge raveling, snags, and runs.
 - b. More than 10 percent loss dimensional instability.
 - c. More than 10 percent loss of tuft-bind strength.
 - d. More than 10 percent loss of face fiber.
 - e. Delamination.
 - f. Excess static discharge.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis of Design: Provide products indicated on Drawings and Interior Finish Schedule.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. Bentley Prince Street, Inc.
 - b. Interface, LLC.
 - c. Milliken & Company.
 - d. Mohawk Group (The); Mohawk Carpet, LLC.
 - e. Tandus; a Tarkett company.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided, recommended or approved by carpet tile manufacturer for project applications.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive, high solids, low VOC emitting formulations that are specifically recommended by carpet tile manufacturer for releasable installation, as verified through compatibility and adhesion testing to suit products and project subfloor conditions indicated, and that comply with flammability requirements for installed carpet tile.
 - 1. VOC Content Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than 3 tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- C. Examine carpet tile for type, color, pattern, and potential defects.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards," Section 7.3, "Site Conditions; Floor Preparation" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch** wide or wider, and protrusions more than **1/32 inch**, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer and as follows:
 - 1. Perimeter tiles: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
 - 2. Field tile: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Carpet Installation Patterns: Comply with requirements indicated on Drawings and Finish Schedules for laying carpet tiles.
- H. Install patterns parallel to walls and borders, unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 099100

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

1.3 DEFINITIONS

- A. General: The following terms apply to this Section. Gloss level shall be determined according to ASTM D 523.
 - 1. Gloss Level 1 (Flat, or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees.
 - 2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 4. Gloss Level 4 (Satin or Low Luster): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 - 5. Gloss Level 5 (Semigloss): 35 to 70 units at 60 degrees.
 - 6. Gloss Level 6 (Gloss): 70 to 85 units at 60-degrees.
 - 7. Gloss Level 7 (High Gloss): More than 85 units at 60 degrees.
- B. Exposed Surfaces: Includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
- C. Interior Surfaces: Interior surfaces to be painted are defined as those surfaces which are indicated in areas exposed to conditions which are controlled by building heating and cooling systems.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated including primers.

1. Product List: An inclusive list of required coating materials. Identify each material by manufacturer's catalog number and general classification. Indicate each material and cross-reference specific coating, paint system, and application. Use same designations indicated on Drawings and in schedules.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis, VOC content, and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Label each coat of each Sample.
 3. Label each Sample for location and application area.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark sample for each type of paint system and substrate required to verify product selections and to demonstrate aesthetic effects and set quality standards for materials and execution. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
1. Architect will select one room or surface to represent surfaces and conditions for application of each paint system.
 - a. Wall and Ceiling Surfaces: Provide samples on surface areas at least 100 square feet.
 - b. Small Areas and Items: Architect will designate items or areas required.
 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate paint systems of a similar nature.
 3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

- B. Store materials not in use in tightly covered containers in a well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Keep storage area neat and orderly.
3. Remove rags and waste from storage areas daily.

1.7 PROJECT CONDITIONS

- A. Apply paints only when temperatures of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.
- B. Do not apply paints in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
1. Quantity: 5 percent, but not less than 1 gallon or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide complete paint systems consisting of compatible products by the following:
1. Benjamin Moore & Co. (Benjamin Moore).
 2. Sherwin-Williams Company (Sherwin-Williams).

2.2 PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Chemical Components of Field-Applied Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Applicable State VOC content limit if more restrictive than requirements indicated.
 2. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 3. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
 4. Anticorrosive Coatings: VOC content of not more than 250 g/L.
 5. Varnishes and Sanding Sealers: VOC content of not more than 350 g/L.
 6. Stains: VOC content of not more than 250 g/L.
 7. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 8. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.

- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors: Comply with requirements indicated on Drawings and Finish Schedules.

2.3 INTERIOR PRIMERS

A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer.

- 1. Benjamin Moore; Eco Spec Interior Latex Primer Sealer 231: Applied at a dry film thickness of not less than 1.0 mils.
- 2. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils.

B. Interior Gypsum Board Primer: Factory-formulated latex-based primer.

- 1. Benjamin Moore; Eco Spec Interior Latex Primer Sealer 231: Applied at a dry film thickness of not less than 1.0 mils.
- 2. Sherwin-Williams; Harmony Interior Latex Primer B11W900: Applied at a dry film thickness of not less than 1.3 mils.

C. Interior Wood Primer: Factory-formulated latex-based primer.

- 1. Benjamin Moore; Eco Spec Interior Latex Primer Sealer 231: Applied at a dry film thickness of not less than 1.0 mils.
- 2. Sherwin-Williams; Harmony Interior Latex Primer B11W900: Applied at a dry film thickness of not less than 1.3 mils.

D. Interior Ferrous-Metal Primer: Factory-formulated latex-based primer.

- 1. Benjamin Moore; IronClad Latex Low Lustre Metal and Wood Enamel 363: Applied at a dry film thickness of not less than 1.6 mils.
- 2. Sherwin-Williams; type recommended by manufacturer for specified top coats.

E. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.

- 1. Benjamin Moore; IronClad Latex Low Lustre Metal and Wood Enamel 363: Applied at a dry film thickness of not less than 1.6 mils.
- 2. Sherwin-Williams; type recommended by manufacturer for specified top coats.

2.4 INTERIOR FINISH COATS

A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-latex paint.

1. Benjamin Moore; Aura Matte Waterborne Interior Paint 522: Applied at a dry film thickness of not less than 1.9 mils.
 2. Benjamin Moore; Eco Spec Interior Latex Flat 219: Applied at a dry film thickness of not less than 1.2 mils.
 3. Sherwin-Williams; Harmony Interior Latex Flat B5 Series: Applied at a dry film thickness of not less than 1.7 mils.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex enamel.
1. Benjamin Moore; Aura Eggshell Waterborne Interior Paint 524: Applied at a dry film thickness of not less than 2.0 mils.
 2. Benjamin Moore; Eco Spec Interior Latex Eggshell Enamel 223: Applied at a dry film thickness of not less than 1.4 mils.
 3. Sherwin-Williams; Harmony Interior Latex Eg-Shel B9 Series: Applied at a dry film thickness of not less than 1.6 mils.
- C. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel.
1. Benjamin Moore; Aura Semi-Gloss Waterborne Interior Paint 528: Applied at a dry film thickness of not less than 1.6 mils.
 2. Benjamin Moore; Eco Spec Interior Latex Semi-Gloss Enamel 224: Applied at a dry film thickness of not less than 1.4 mils.
 3. Sherwin-Williams; Harmony Interior Latex Semi-Gloss B10 Series: Applied at a dry film thickness of not less than 1.6 mils.

2.5 INTERIOR WOOD STAINS AND VARNISHES

- A. Open-Grain Wood Filler: Factory-formulated paste wood filler applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Benwood Paste Wood Filler No. 238.
 2. Sherwin-Williams; Sher-Wood Fast-Dry Filler.
- B. Interior Wood Stain: Factory-formulated alkyd-based penetrating wood stain for interior application applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Benwood Penetrating Stain No. 234.
 2. Sherwin-Williams; Wood Classics Interior Oil Stain A-48 Series.
- C. Clear Sanding Sealer: Factory-formulated fast-drying alkyd-based clear wood sealer applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Moore's Interior Wood Finishes Quick-Dry Sanding Sealer No. 413.
 2. Sherwin-Williams; Wood Classics Fast Dry Sanding Sealer B26V43.
- D. Interior Waterborne Clear Satin Varnish: Factory-formulated clear satin acrylic-based polyurethane varnish applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Stays Clear Acrylic Polyurethane No. 423, Satin.
 2. Sherwin-Williams; Wood Classics Waterborne Polyurethane Satin, A68 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry: 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- D. Comply with procedures specified in PDCA P4 for inspection and acceptance of surfaces to be painted.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. General: Comply with manufacturer's written instructions applicable to substrates, conditions, and paint systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 2. Provide barrier coats over incompatible primers or remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete and Cementitious Substrates: Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, and curing compounds. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Clean ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, rust, loose mill scale, and other foreign substances. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized Substrates: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
 - 1. Scrape and clean knots, and apply a coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view smooth and dust off.
 - 3. Prime or seal wood immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- J. Previously Coated Surfaces:
 - 1. Clean all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, sealers and compounds to assure bonding to previous coatings that are tightly adhered.
 - 2. Clean and dull glossy surfaces of old paint films before repainting.
 - 3. Thoroughly wash surfaces with an abrasive cleanser that will clean and dull in one operation, or, wash thoroughly and dull by sanding.
 - 4. Spot prime any bare areas with the appropriate primer.
 - 5. Check coating compatibility by applying a minimum 4 square feet test patch of the scheduled coating system. Allow test patch to dry one week before testing

adhesion in accordance with ASTM D 3359. Remove existing coating completely if coating system is not compatible (adhesion failure).

- K. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 PAINTING – GENERAL

- A. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- B. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Finished mechanical and electrical equipment.
 - c. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.
 - d. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 4. Operating parts include moving parts of operating equipment and the following:

- a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

3.4 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions.
1. Use applicators and techniques best suited for paint and substrate indicated.
 2. Provide finish coats that are compatible with primers used.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 6. Paint front and backsides of access panels and removable or hinged covers, and similar hinged items to match exposed surfaces.
 7. Sand lightly between each succeeding enamel or varnish coat.
- B. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat when multiple coats of same material are applied. Tint undercoats to match color of the topcoat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.
1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or

feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton, canvas, and all-service jackets or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
- J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage a qualified independent testing agency to sample paint materials being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces previously painted with the noncomplying materials. Contractor will be required to remove noncomplying paint materials from previously painted surfaces if, on repainting with complying materials, the two paints or coatings are incompatible.

3.6 CLEANING

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping or other methods. Do not scratch or damage adjacent finished surfaces.

3.7 PROTECTION

- A. Protect work against damage from paint application. Correct damage to work by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in undamaged condition.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings.
- C. Touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- D. At completion of construction activities, touch up and restore damaged or defaced painted surfaces.

3.8 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and masonry substrates:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete and masonry primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- B. Gypsum Board: Provide the following paint systems over interior gypsum board surfaces:
 - 1. Flat Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior flat acrylic paint.
 - 2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- C. Wood Substrates for Opaque Finish: Provide the following paint finish systems over interior wood surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior wood primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - 2. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior wood primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- D. Wood Substrates for Interior Stain and Transparent Finish: Provide the following coating systems over interior wood surfaces:
 - 1. Waterborne Stain Satin-Varnish Finish: Two finish coats of waterborne clear satin varnish over a sealer coat and waterborne interior wood stain. Wipe wood filler before applying stain.
 - a. Filler Coat: Open-grain wood filler.
 - b. Stain Coat: Interior wood stain.
 - c. Sealer Coat: Clear sanding sealer.
 - d. Finish Coats: Interior waterborne clear satin varnish.
- E. Wood Substrates for Natural Transparent Finish: Provide the following coating systems over interior wood surfaces:
 - 1. Waterborne Satin-Varnish Finish: Two finish coats of waterborne clear satin varnish over a sanding sealer. Wipe wood filler before applying stain.
 - a. Filler Coat: Open-grain wood filler.
 - b. Sealer Coat: Clear sanding sealer.

- c. Finish Coats: Interior waterborne clear satin varnish.
- F. Ferrous Metal: Provide the following paint systems over ferrous metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- G. Zinc-Coated Metal: Provide the following paint systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION 099100

SECTION 102800
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Toilet room accessories.
- 2. Warm-air dryers.
- 3. Childcare accessories.

- B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for blocking supports.
- 2. Section 09 30 13 "Ceramic Tiling."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- 3. Include electrical characteristics.

- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

- 1. Identify locations using room designations indicated on Drawings.
- 2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.
- B. Keys.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

1.7 QUALITY ASSURANCE

- A. Standards for Accessible Design: Comply with the following:
 - 1. New Jersey Barrier-Free Subcode incorporating the technical standards of ICC ANSI A117.1.
 - 2. U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

1.8 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.

- E. Galvanized-Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.
- J. Fasteners: Type recommended by toilet accessory manufacturer for project applications.
 - 1. Fabricate components from stainless steel unless specifically recommended otherwise, in writing, by toilet accessory manufacturer.

2.2 TOILET ACCESSORIES

- A. Source Limitations: Obtain each type of toilet accessory through one source from a single manufacturer.
- B. Basis of Design: Project design and Contract Documents are based on products specified.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
- C. TA1: Grab Bar.
 - 1. Basis of Design: "Model B-5806 x 42"; Bobrick Washroom Equipment, Inc.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material and Finish: Stainless steel, 0.05 inch thickness; smooth, No. 4 finish (satin).
 - 4. Outside Diameter: 1-1/4 inches.
 - 5. Configuration: Straight.
 - 6. Length: 42 inches.
- D. TA2: Grab Bar.
 - 1. Basis of Design: "Model B-5806 x 18"; Bobrick Washroom Equipment, Inc.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material and Finish: Stainless steel, 0.05 inch thickness; smooth, No. 4 finish (satin).
 - 4. Outside Diameter: 1-1/4 inches.
 - 5. Configuration: Straight.
 - 6. Length: 18 inches.

E. TA3: Grab Bar.

1. Basis of Design: "Model B-5806 x 36"; Bobrick Washroom Equipment, Inc.
2. Mounting: Flanges with concealed fasteners.
3. Material and Finish: Stainless steel, 0.05 inch thickness; smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/4 inches.
5. Configuration: Straight.
6. Length: 36 inches.

F. TA4: Toilet Tissue (Roll) Dispenser.

1. Basis of Design: "Model TP-2"; Royce Rolls Ringer Company.
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle equipped with master lock.
5. Capacity: Designed for 5-inch diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

G. TA5: Warm-Air Hand Dryer.

1. Basis of Design: "Model DXRM5-Q973"; World Dryer Corporation.
2. Description: High-speed, warm-air hand dryer for rapid hand drying.
3. Mounting: Recessed, with low-profile design.
4. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.
5. Cover Material and Finish: Stainless steel, No. 4 finish (satin).
6. Electrical Requirements: 115 V, 20 A, 2300 W.

H. TA6: Waste Receptacle.

1. Basis of Design: "Model B-43644"; Bobrick Washroom Equipment, Inc.
2. Mounting: Open top, recessed.
3. Minimum Capacity: 12.8 gallon.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
5. Liner: Reusable vinyl liner.
6. Lockset: Tumbler type for waste receptacle.

I. TA7: Automatic Foam-Soap Dispenser.

1. Basis of Design: "Model SJS-1150"; Sloan Jansan Divion/Sloan Valve Company.
2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in foam or lather form.
3. Finish: Polished chrome finish.
4. Mounting: Wall mounted.
5. Refill Indicator: LED indicator.
6. Low Battery Indicator: LED indicator.

J. TA8: Diaper-Changing Station.

1. Basis of Design: "Model KB100-00ST"; Koala Kare Products.

- a. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - 1) American Specialties, Inc.
 - 2) Diaper Deck & Company, Inc.
 - 3) Foundations Children's Products.
 - 4) SafeStrap Company, Inc. (SSC, Inc.).
 2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb static load when opened.
 3. Mounting: Recessed, with unit projecting not more than 1 inch from wall when closed.
 4. Operation: By pneumatic shock-absorbing mechanism.
 5. Material and Finish: HDPE unit with stainless steel wall flange.
 - a. HDPE color: Cream.
 - b. Stainless steel finish: No. 4 finish (satin).
 6. Liner Dispenser: Built in.
- K. TA9: Coat Hook.
1. Basis of Design: "Model B-2116"; Bobrick Washroom Equipment, Inc.
 2. Description: Heavy-duty, single-prong unit.
 3. Material and Finish: One piece brass casting with satin nickel-plated finish.
 - a. Engineered to support minimum of 300-lb static load.
- L. TA10: Mirror Unit.
1. Frame: Stainless-steel angle or channel; No. 4 finish (satin).
 - a. Corners: Mitered, welded and ground smooth.
 2. Width: 24 inches.
 3. Height: 68 inches.
 4. Backing: Manufacturer's standard; suitable for mounting with mechanical fasteners.
- M. TA11: Mirror Unit.
1. Frameless, 28-inch diameter, circular unit.
 2. Backing: Manufacturer's standard; suitable for mounting with mechanical fasteners.

2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of 6 keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Mounting Locations and Heights: Install accessories to comply with requirements indicated on Drawings and accessible design standards.
- C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 28 00

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets.
- C. Contract Closeout Submittals: Operation and maintenance data suitable to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by FMG or an independent testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - 2. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - 3. Larsen's Manufacturing Company.
 - 4. Potter Roemer LLC.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet indicated.
- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, **10-lb** nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
 - 1. Valves: Manufacturer's standard.
 - 2. Handles and Levers: Manufacturer's standard.
 - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

2.3 FIRE-PROTECTION CABINET

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - 2. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - 3. Larsen's Manufacturing Company.
 - 4. Potter Roemer LLC.
- B. Basis of Design: "Occult Series"; Larsen's Manufacturing Company
- C. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
 2. Cabinet Capacity: Suitable for fire extinguisher.
 3. Cabinet Construction: Nonrated.
 4. Cabinet Material: Enameled-steel sheet.
- D. Door Style: Vertical duo panel with frame.
1. Door Material: Enameled-steel sheet.
 2. Door Glazing: Tempered float glass (clear).
- E. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide door pull and friction latch.
 2. Provide concealed hinges permitting door to open 180 degrees.
- F. Identification: Provide lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
1. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - a. Location: Applied to cabinet door.
 - b. Application Process: Engraved.
 - c. Lettering Color: Black.
 - d. Orientation: Vertical.
- G. Finishes: Manufacturer's standard baked-enamel paint finish for the following:
1. Exterior of cabinet, door, and trim.
 2. Interior of cabinet and door.
 3. Color and gloss: Match Architect's samples.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch** thick.
 2. Miter and weld perimeter door frames.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish fire-protection cabinets after assembly.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated.
 - 1. Fire-Protection Cabinets: **48 inches** above finished floor to top of cabinet, unless otherwise indicated.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104400

SECTION 115213
PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Electrically operated, front-projection screens and controls.

- B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for wood framing and blocking for screen installation.

1.3 DEFINITIONS

- A. Gain: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
- B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
 - 1. Screen size.
 - 2. Location of screen centerline relative to ends of screen case.
 - 3. Anchorage details, including connection to supporting structure for suspended units.
 - 4. Details of juncture of exposed surfaces with adjacent finishes.
 - 5. Location of wiring connections for electrically operated units.
 - 6. Wiring diagrams for electrically operated units.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver or install front-projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling framing and suspension systems, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

- A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Controls: Remote, 3-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - 3. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
 - 4. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch diameter metal rod with ends of rod protected by plastic caps.
- B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure, with Motor-in-Roller, and without Tab Tensioning: Units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.

1. Basis of Design: "Advantage Deluxe Electrol"; Da-Lite Screen Company.
2. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturer may be considered:
 - a. Draper Inc.
 - b. Stewart Filmscreen Corporation.
3. Provide metal or metal-lined wiring compartment.
4. Screen Case: Fabricate top, back and front of screen case from extruded aluminum or cold-rolled steel sheet.
5. Provide screen case with trim flange to receive ceiling finish.
6. Finish on Exposed Surfaces: Manufacturer's factory-applied coated finish.
 - a. Color: White.

C. Screen Material and Viewing Surface:

1. Basis of Design: "Matte White"; Da-Lite Screen Company.
2. Matte-White Viewing Surface: Peak gain of not less than 0.9, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
 - a. Format: Wide (16:10).
3. Material: Vinyl-coated, glass-fiber fabric.
 - a. Mildew-Resistance Rating: Zero or 1 when tested according to ASTM G 21.
 - b. Flame Resistance: Passes NFPA 701.
 - c. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
4. Seamless Construction: Provide screens in sizes indicated without seams.
 - a. Size of Viewing Surface: 60 inches by 96 inches.
5. Edge Treatment: Without black masking borders.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
 1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.

- a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

3.2 PROTECTING

- A. After installation, protect projection screens from damage during remainder of construction.

END OF SECTION 11 52 13

SECTION 122200
CURTAINS AND DRAPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Drapes.
 - 2. Drapery tracks.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Drapery Tracks: Include maximum weights of drapes that can be supported.
 - 2. Fabrics.
 - 3. Textile treatments.
- B. Shop Drawings:
 - 1. Drapery Tracks: Show installation and anchorage details and locations of controls.
 - 2. Drapes: Show sizes, locations, and details of installation.
- C. Samples for Verification:
 - 1. Drapery Tracks: 18 inches long, with carriers, controls, and accessories.
 - 2. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.
 - 3. Drape Fabrication: For each heading, fabric, color, and pattern indicated, a complete full-size panel to verify details of fabrication and thread colors.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treatment durability and cleaning procedures required to maintain treatment effectiveness.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For products installed to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of drapes.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before drape fabrication, and indicate measurements on Shop Drawings.
- B. Scheduling: Do not deliver or install drapes until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Forest Drapery Hardware.
 - 2. Kirsch.
 - 3. Springs Window Fashions.
- B. Manually Operated Track:
 - 1. Product Standard: Provide drapery tracks operated by pull cords complying with WCMA A 100.1.
 - 2. Construction: Extruded aluminum, slotted for mounting at interval of not more than **24 inches** on center.
 - a. Lengths and Configurations: As indicated on Drawings.
 - b. Support Capability: Weight of drape indicated, mounted on track length indicated.
 - c. Finish: White baked enamel.
 - 3. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drape plus force applied to operate track.
 - a. Mounting Surface: Drapery pocket as indicated on Drawings.
 - b. Size: Adjustable.

4. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide a minimum of two fasteners to fasten each bracket to supporting construction.
5. Operation: Baton.
 - a. Draw: One way, stack as indicated on Drawings.
 - b. Operating Hardware Location: On stack side, as indicated on Drawings.
6. Carriers: Rollers with snaps.
 - a. Master Carriers: Butt.
7. End Stops: Manufacturer's standard with track end cap.
8. Pulleys: Heavy duty.
9. Accessories: Manufacturer's standard units.

2.2 DRAPES

- A. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.
- B. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Drape:
 1. Heading:
 - a. Roll Pleats, Ripplefolds: 120 percent fullness.
 - b. Heading Accessories: Woven snap tape, **7/8 inch** wide, with nickel-plated snaps at **4 inches** on center.
 2. Drapery Fabric:
 - a. Basis of Design: "Creation Baumann Basilica"; Carnegie.
 - b. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - 1) DesignTex Inc.
 - 2) Maharam.
 - c. Pattern: No. 5515.
 - d. Color: No. 216.
 - e. Fiber Content: 100 percent Trevira CS Polyester.
 - f. Orientation: Run right (up the bolt).
 3. Lining Fabric: Type recommended by drapery fabric manufacturer for drapery fabric and project application.
 4. Textile Treatments: Stain repellent; and flame retardant, polymer type.

5. Hem Weights: 1-inch square lead weights.

2.3 DRAPE FABRICATION

- A. Fabricate drapes in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.
 1. One-Way-Stacking Drapes: Add 5 inches to overall width for returns.
- B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are unacceptable.
- C. Side Hems: Double-turned, 1-1/2-inch wide hems consisting of three layers of fabric, and blindstitched so that stitches are invisible on face of drape.
- D. Bottom Hems: Double-turned, 4-inch wide hems consisting of three layers of fabric, and weighted and blindstitched so that weights and stitches are invisible on face of drape.
 1. Sew in square lead weights at each seam and at panel corners.
- E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch return of face fabric.
 1. Bottom Hem: Hem separately from drapery fabric.

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

- A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.
- B. Isolate metal parts of tracks and brackets from adjoining materials to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.2 DRAPE INSTALLATION

- A. Where drapes abut overhead construction, hang drapes so that clearance between headings and overhead construction is 1/4 inch.
- B. Where drapes extend to floor, install so that bottom hems clear finished floor by not more than 1 inch and not less than 1/2 inch.

3.3 ADJUSTING

- A. After hanging drapes, test and adjust each drapery track to produce unencumbered, smooth operation.
- B. Steam and dress down drapes as required to produce crease- and wrinkle-free installation.
- C. Remove and replace drapes that are stained or soiled.

END OF SECTION 12 22 00

SECTION 122413
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated roller shades with single rollers.

- B. Related Requirements:

- 1. Division 6 Section "Rough Carpentry" for wood blocking for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include plans, elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work. Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and seam locations.
- C. Samples for Selection: Submit manufacturer's full range samples for components that require color and finish selection.
- D. Samples for Verification: Submit for each type of roller shade.
 - 1. Shadeband Material: Not less than 24 inches square. Mark inside face of material if applicable.
 - 2. Installation Accessories: Full-size unit, not less than 12 inches long.
- E. Roller-Shade Schedule: Include location, type and size for each roller shade. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit data suitable for inclusion in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain roller shades and shadeband materials through one source from a single manufacturer.
- B. Qualifications: Comply with the following:
 - 1. Fabricator Qualifications: A firm or shop that employs skilled workers who custom-fabricate roller window shade assemblies comparable in material, design, and extent to that indicated for this Project, and whose work has resulted in construction installations with a record of successful in-service performance for a minimum period of 5 years.
 - 2. Installer Qualifications: Fabricator of roller window shades or a firm which is authorized by manufacturer and specialized in the installation of roller window shade assemblies comparable in material, design, and extent to that indicated for this Project, and whose work has resulted in construction installations with a record of successful in-service performance for a period of 5 years.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate

measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. DFB Sales.
 - 2. Draper Inc.
 - 3. Hunter Douglas Contract.
 - 4. MechoShade Systems, Inc.
 - 5. Silent Gliss USA, Inc.
- B. Basis of Design: Project design is based on products manufactured by MechoShade Systems, Inc.
 - 1. Manually operated roller shades with single rollers: "Mecho/5" Manual Shade; MechoShade Systems, Inc.
 - 2. Product Options: Drawings indicate sizes, configurations, arrangements, alignment and dimensional requirements of roller shades as they relate to sightlines, to one another, and to adjoining construction
 - 3. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 MANUALLY OPERATED ROLLER SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Stainless steel or nickel-plated metal.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
 - 2. Operating Function: Stop and hold shade at any position in ascending or descending travel.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-

end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade, unless otherwise indicated.
 2. Direction of Shadeband Roll: Regular, from back of roller, unless otherwise indicated.
 3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Shadebands:
1. Shadeband Material: Provide products indicated on Drawings and Interior Finish Schedule.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material with exposed plastic or metal endcaps.
- E. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than **4 inches**.
 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than **4 inches**.
 3. Endcap Covers: To cover exposed endcaps.
 4. Installation Accessories Color and Finish: Match Architect's control samples.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 degrees F:
 - 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION – GENERAL

- A. General:
 - 1. Comply with manufacturer's written instructions and approved shop drawings unless project conditions require more stringent requirements for performance of the work.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.

3.3 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

- 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.4 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.5 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades.

END OF SECTION 12 24 13

SECTION 123640
STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes stone countertops.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry."
 - 2. Section 07 92 00 "Joint Sealants."

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each variety of stone: Include data on physical properties required by referenced ASTM standards.
 - 2. Stone accessories and other manufactured products.
- B. Shop Drawings:
 - 1. Include plans, sections, details, and attachments to other work.
 - 2. Show direction of veining, grain, or other directional pattern.
- C. Samples for Verification: Submit 6-inch square samples for each stone type indicated. Include two or more Samples in each set and show the full range of variations in appearance characteristics expected in completed Work.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For stone countertops to include in maintenance manuals. Include product data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone countertops.
- C. Source Limitations for Stone: Obtain each variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
- B. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using handle dollies with cushioned wood supports.
- C. Store stone on wood A-frames or pallets with nonstaining separators and nonstaining waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

- A. Granite: Comply with ASTM C 615.
 - 1. Description: Uniform, fine- to medium-grained stone without veining.
 - 2. Variety: As indicated on Drawings and Interior Finish Schedule.
 - 3. Cut: Fleuri cut.
 - 4. Cut stone from contiguous, matched slabs in which natural markings occur.
 - 5. Thickness: Not less than 1-1/4 inches, unless otherwise indicated.
 - 6. Finish: Polished.
 - 7. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.2 STONE ACCESSORIES

- A. General: Use only adhesives formulated for stone and recommended by their manufacturer for the application indicated.
- B. Water-Cleanable Epoxy Adhesive: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Custom Building Products.
 - b. Laticrete International, Inc.
 - c. MAPEI Corp.
- C. Miscellaneous Anchors and Fasteners: Stainless steel.
- D. Plywood Subtops: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- E. Sealant for Countertops: Provide products specified in Section 079200.
- F. Stone Cleaner: Cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- G. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hillyard, Inc.
 - b. HMK Stone Care System; ACI International.
 - c. Miracle Sealants Company.
 - d. Stone Care International Inc.

2.3 STONE FABRICATION, GENERAL

- A. General: Comply with fabrication recommendations of the following:
 - 1. NBGQA's "Specifications for Architectural Granite."
 - 2. MIA's "Dimension Stone--Design Manual."
- B. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that may impair structural integrity, function, or appearance.
 - 1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically displeasing, as judged by Architect.

- C. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.
- D. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated.
 - 1. Clean sawed backs of stones to remove rust stains and iron particles.
 - 2. Dress joints straight and at right angle to face unless otherwise indicated.
 - 3. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
 - 4. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
 - 5. Finish exposed faces of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples. Provide matching finish on exposed edges of countertops and cutouts.
- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

2.4 STONE COUNTERTOPS

- A. General: Comply with recommendations of the following:
 - 1. NBGQA's "Specifications for Architectural Granite."
 - 2. MIA's "Dimension Stone--Design Manual."
- B. Nominal Thickness: Provide thickness indicated, but not less than 1-1/4 inches. Gage backs to provide units of identical thickness.
- C. Edge Detail: Straight, slightly eased at top.
- D. Joints: Fabricate countertops without joints.
- E. Cutouts and Holes:
 - 1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - 2. Fittings: Drill countertops in shop for plumbing fittings and similar items.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive stone countertops and conditions under which stone countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by stone countertop Installer for anchoring stone countertops. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Before setting stone countertops, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives and rinse with clear water. Allow stone to dry before installing.

3.3 INSTALLATION OF COUNTERTOPS

- A. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
- B. Do not cut stone in field. If stone countertops require additional fabrication, return to fabrication shop for adjustment.
- C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Shim and adjust stone to locations indicated, with edges and faces aligned according to established relationships and indicated tolerances. Install anchors and other attachments indicated or necessary to secure stone countertops in place.
- D. Apply mildew-resistant silicone sealant at perimeter joints between countertops and adjacent wall surfaces. Comply with Section 079200 "Joint Sealants." Remove temporary shims before applying sealant.

3.4 CONSTRUCTION TOLERANCES

- A. Variation from Level: Do not exceed 1/16 inch in 96 inches.
- B. Variation from Plumb: Do not exceed 1/16 inch in 96 inches.

3.5 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive and sealant smears immediately.
- B. Remove and replace stone countertops of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 - 2. Defective countertops.
 - 3. Interior stone countertops not matching approved Samples.
 - 4. Interior stone countertops not complying with other requirements indicated.
- C. Replace in a manner that results in stone countertops matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- D. Clean stone countertops no fewer than 7 days after completion of sealant installation, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that may damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 12 36 40

SECTION 124813

ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes resilient entrance mats and frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.
- B. Shop Drawings: Show the following:
 - 1. Items penetrating floor mats and frames, including door control devices.
 - 2. Perimeter frames.
- C. Samples for Verification: For each type of product indicated.
 - 1. Floor Mats: 6-inch-square assembled sections.
 - 2. Frame Members: 6-inch-long samples.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Standards for Accessible Design: Comply with the following:
 - 1. New Jersey Barrier-Free Subcode incorporating the technical standards of ICC ANSI A117.1.
 - 2. U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.6 FIELD CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate installation of floor mats and frames with installation of adjacent flooring materials.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS

- A. Basis-of-Design: "Super Brush Mat"; American Floor Mats.
 - 1. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following may be considered:
 - a. Amarco Products.
 - b. Mats Incorporated.
- B. Entrance Floor Mat: Constructed from 100 percent synthetic, solution dyed fibers to resemble natural cocoa mats; permanently bonded to high-density rubber backing for dimensional stability and resistance to shedding.
 - 1. Mat Size: As indicated on Drawings.
 - 2. Color: Black Walnut.

2.2 FRAMES

- A. Architectural Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500.

2.3 CONCRETE FILL AND GROUT MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor mat manufacturer for applications indicated.

2.4 FABRICATION

- A. Fabricate floor mats to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints

2.5 COPPER-ALLOY (BRONZE) FINISHES

- A. Finish designations prefixed by CDA comply with the system established by the Copper Development Association for designating copper-alloy finishes, as defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
 - 1. Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.
- B. CDA Mechanical Finish Designation: M32, directionally textured, medium satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions, with Installer present, for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch deviation in any direction when checked with a 12-foot straight edge.
 - 1. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- B. Broom or vacuum clean substrates to be covered before product installation.

3.3 INSTALLATION

- A. General: Install floor mats and frames to comply with manufacturer's written instructions and approved shop drawings.
 - 1. Coordinate floor mat installation with entrance locations and traffic patterns.
 - 2. Set top of mats at height recommended by manufacturer for most effective cleaning action.

3. Coordinate top of mat surfaces with bottom of doors that swing across mats to provide proper clearance between doors and mats.
4. Maintain transitions between floor mats, frames and adjacent flooring materials to comply with accessible design standards.
5. Secure frame members to floor with anchors spaced as recommended by manufacturer.

3.4 PROTECTION

- A. Protect completed installation and maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 12 48 13

210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 GENERAL

- A. This section includes pipe, fittings, valves, and connections for sprinkler and standpipe systems in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 5. ASME B16.25 - Buttwelding Ends.
 6. ASME B16.3 - Malleable Iron Threaded Fittings.
 7. ASME B16.4 - Gray Iron Threaded Fittings.
 8. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 9. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
 10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
- B. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
 3. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

4. ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

C. National Fire Protection Association:

1. NFPA 13 - Installation of Sprinkler Systems.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- B. Product Data: Submit manufacturer's catalogue information. Indicate valve data and ratings.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and tag numbering.
- B. Operation and Maintenance Data: Submit spare parts lists.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with the State of New Jersey and all applicable codes.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Furnish cast iron and steel valves with temporary protective coating.

- C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.09 EXTRA MATERIALS

- A. Furnish two sets of valve stem packing for each size and type of valve installed.

PART 2 - PRODUCTS

2.01 VALVES

- A. Furnish materials in accordance with the state of New Jersey and all applicable codes.
- B. Gate Valves:
 - 1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid [rubber covered] bronze or cast iron wedge, grooved ends.
 - 3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
- C. Globe or Angle Valves:
 - 1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity packable under pressure.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
- D. Ball Valves:
 - 1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
 - 2. Over 2 inches: Manufacturers: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive hand wheel for sizes 10 inches and over, flanged.

E. Butterfly Valves:

1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

F. Check Valves:

1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
3. 4 inches and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

G. Drain Valves:

1. Compression Stop: Bronze with hose thread nipple and cap.
2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A53/A53M, Grade B; Schedule 40 black.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends.
2. Malleable Iron Fittings: ASME B16.3, threaded fittings.
3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
4. Mechanical Formed Fittings: Carbon-steel housing with integral pipe stop and O-ring pocked and O-ring uniformly compressed into permanent mechanical engagement onto pipe.

- B. Steel Pipe: ASTM A53/AS3M Grade B: Schedule 40 Galvanized.
 - 1. All fittings to be the same as indicated above with galvanized coating.
 - 2. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 5. Mechanical Formed Fittings: Carbon-steel housing with integral pipe stop and O-ring pocked and O-ring uniformly compressed into permanent mechanical engagement onto pipe.
 - 6. Refer to sprinkler contract drawings for location of all galvanized pipes.

2.03 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 13.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp; angle ring.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- J. Refer to construction documents for pipe support to roof deck.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install pipe sleeve at piping penetrations through footings, partitions, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13.
 - 2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.

- 7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 099000.
- J. Do not penetrate building structural members unless indicated. Refer to structural drawings for exact location of steel penetration.
- K. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- L. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- N. Install gate or butterfly valves for shut-off or isolating service.
- O. Install drain valves at main shut-off valves, low points of piping and apparatus.
- P. Where inserts are omitted, drill through concrete slab from below and install through-bolt with recessed square steel plate and nut flush with top of slab.
- Q. Refer to construction documents for pipe layout.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.04 CLEANING

- A. Clean entire system after other construction is complete.

END OF SECTION

SECTION 210516 - EXPANSION FITTINGS AND LOOPS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for expansion fittings and loops in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Flexible pipe connectors.
 - 2. Expansion joints.
 - 3. Expansion compensators.
 - 4. Pipe alignment guides.
 - 5. Swivel joints.
 - 6. Pipe anchors.
- B. Related Sections:
 - 1. Section 21 05 00 - Common Work Results for Fire Suppression: Product and installation requirements for piping used in fire protection systems.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.9 - Building Services Piping.
 - 2. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.

1.03 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees F.
 - 2. Fire Protection System Temperature: 50 degrees F.
 - 3. Safety Factor: 30 percent.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- D. Manufacturer's Installation Instructions: Submit special procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of NY.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

- A. Section 01 00 00 – General Conditions: Product warranties and product bonds.

1.11 EXTRA MATERIALS

- A. Supply two 12 ounce containers of packing lubricant and cartridge style grease gun.

PART 2 - PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS

- A. Steel Piping:
 - 1. Inner Hose: Carbon Steel.
 - 2. Exterior Sleeve: Stainless steel.
 - 3. Pressure Rating: 200 psig and 250 degrees F.
 - 4. Joint: Flanged.

5. Maximum offset: 1 inch on each side of installed center line.

2.02 EXPANSION JOINTS

A. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig and 250 degrees F.
2. Maximum Compression: 3 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified for pipe joints.
5. Application: Steel piping 3 inch and smaller.

B. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig and 250 degrees F.
2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 5/16 inch.
4. Maximum Offset: 1/8 inch.
5. Joint: Flanged.
6. Accessories: Internal flow liner.
7. Application: Steel piping 3 inch and larger.

C. Two-ply Bronze Bellows Type:

1. Construction: Bronze with anti-torque device, limit stops, internal guides.
2. Pressure Rating: 200 psi and 250 degrees F.
3. Maximum Compression: 3 inch.
4. Maximum Extension: 1/4 inch.
5. Joint: Flanged.
6. Application: Copper piping.

2.03 ACCESSORIES

- ### A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

- B. Swivel Joints: Fabricated steel body, double ball bearing race, field lubricated, with (Buna-N) o-ring seals.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- C. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.
- D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 21 05 00 for pipe hanger installation requirements.
- E. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- F. Provide expansion loops as indicated on Drawings.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 210548 - SEISMIC PROVISIONS AND SEISMIC RESTRAINTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labor and material to install, test, and to place into operation Seismic restraints for piping and equipment.
2. All piping, equipment, etc. shall be seismically restrained in accordance with the requirements of the IBC New Jersey Edition.

B. Related Sections:

1. Requirements of Section 21 05 00 shall also govern work specified herein, together with all applicable paragraphs of Fire Protection sections.

1.2 SUBMITTALS

A. The submittal material shall include descriptive data for all products and materials including but not limited to, the following:

1. Descriptive Data:

- a. Catalog cuts and data sheets on specific vibration isolators and restraints to be utilized showing compliance with the specifications.
- b. Testing reports.

B. Shop Drawings:

1. Drawings showing methods of suspension, support guides for piping and equipment.
2. Concrete and steel details for bases including anchor bolt sizes and locations.
3. Number and location of seismic restraints and anchors for each piece of equipment.
4. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and piping.

5. Purchased and/or fabricated equipment must be designed to safely accept external forces in accordance with IBC New Jersey Edition in any direction for all rigidly and resiliently supported equipment and piping without failure and permanent displacement of the equipment. Substitution of "Internally Isolated" mechanical equipment in lieu of the specified isolation must be approved for individual equipment units and is acceptable only if above accelerations are certified in writing by equipment manufacturer and stamped by a licensed civil or structural engineer.

1.3 REFERENCE STANDARDS

- A. International Building Code – New Jersey Edition.
- B. ANSI/SMACNA Seismic Restraint Manual.
- C. Where conflicts exist between the two reference standards, the requirements of the more stringent standard shall apply.

1.4 MANUFACTURER RESPONSIBILITIES

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities.
 1. Determine vibration isolation and seismic restraint sizes and locations.
 2. Guarantee specified isolation system deflection.
 3. Provide installation instructions, drawings and field supervision to assure proper installation and performance.

PART 2 PRODUCTS

2.1 GENERAL

- A. Seismic restraints shall maintain equipment and piping in a captive position. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise and shall be provided on all equipment as noted in Division 23 Specifications.
- B. Details of support methods for typical conditions are described herein. Actual method(s) of restraint for all equipment shall be submitted by the manufacturer of each piece of equipment accompanied by a letter indicating compliance with the criteria established. The Contractor shall provide restraints as indicated on approved Shop Drawings.

2.2 REQUIRED APPLICATIONS

- A. All equipment which is bolted directly to concrete housekeeping pads.
- B. All floor mounted equipment mounted on vibration isolators.
- C. All piping and equipment supported from overhead.
- D. Wall hung equipment.
- E. All floor-mounted pipes and ducts are not secured to seismic floor stands.

2.3 TYPES OF RESTRAINTS

- A. Seismic Restraint, Type I:
 - 1. Each corner or side seismic restraint shall incorporate minimum 5/8" thick pad limit stops. Restraints shall be made of plate, structural members or square metal tubing in a welded assembly, incorporating resilient pads. Angle bumpers are not acceptable. System to be field bolted to structure to resist seismic forces in accordance with the NYCBC.
 - 2. Seismic spring mountings as described above are an acceptable alternative providing all seismic loading requirements are met.
 - 3. Mason Industries Type Z-1011, Type Z-1225, or approved equal.
- B. Seismic Restraint, Type II:
 - 1. Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to structure or overhead structural members or structure with aircraft cable.
- C. Spring Seismic Restraint, Type III:
 - 1. Shall comply with general characteristics of spring isolators. Shall incorporate snubbing restraint in all directions. Shall be capable of supporting equipment at a fixed elevation during equipment erection. Cast or aluminum housings are not acceptable. System to be field bolted to deck to resist seismic forces in accordance with the Building Code.
 - a. Mason Type SSLFH, or as approved equal.
 - b. VMCI Type SAWR
 - c. VEC Type BXL
- D. Bolted Seismic Restraint, Type IV:

1. Non-isolated equipment shall be field bolted (powder shots not acceptable) to resist seismic forces unless under 100 pound shear force required.

PART 3 EXECUTION

3.1 UTILIZATION

- A. Equipment and piping supported from overhead:
 1. Utilize Seismic Restraint Type II restraining system.
 2. For overhead supported equipment, overstress of the building structure must not occur.
 3. All structurally suspended overhead equipment, isolated or un-isolated, shall be four-point independently braced with Type II seismic restraining system.
 4. Install seismic restraining system Type II: taut for overhead suspended un-isolated equipment, piping or ductwork, and slack with 1/2" cable deflection for isolated system.
- B. Equipment mounted directly to concrete housekeeping pads:
 1. Utilize Seismic Restraint Type IV and Type I.
 2. Bolt sizes and configurations shall be arranged to resist seismic forces in accordance with the Building Code. Bolt points and diameter of inserts shall be submitted and verified as part of the contractor's submission for each piece of equipment and certified by a licensed civil or structural engineer.
 3. Where base anchoring is insufficient to resist seismic forces, supplementary restraining such as seismic restraint system Type II or rigid channel supports shall be used above system's center of gravity to suitably resist seismic forces in accordance with the Building Code. Floor mounted distribution equipment may require this additional restraint.
- C. Equipment mounted on vibration isolators:
 1. Equipment mounted on springs shall utilize Seismic Restraint Type III (spring mounts) and do not require additional seismic restraints providing that the spring mountings:
 - a. Comply with general characteristics of spring isolators.

- b. Have vertical limit stops and are capable of supporting equipment at fixed elevation during equipment erection.
 - c. Incorporate seismic snubbing restraint in all directions at specified acceleration loading.
 - 2. Where equipment weight or characteristics exceed capacity of seismic spring mounts, equipment shall be mounted on standard spring isolators, Mason Industries Type SLR or approved equal and provided with Seismic Restraint Type I restraints.
- D. Wall mounted equipment, piping and ductwork:
 - 1. Provide and install insert anchors for concrete walls and through bolts with plates for concrete masonry unit and framed walls in accordance with approved submittals.
 - 2. Anchor cabinets and boxes to wall with anchors or bolts. In framed walls, framing shall be constructed to accept horizontal forces from dynamic load under horizontal forces from applicable IBC – New Jersey Edition.

END OF SECTION

SECTION 211313 - SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes wet-pipe sprinkler system, system design, installation and certification in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 260519 – Low-voltage electrical power conductors and cables: Execution requirements for electric connections to equipment specified by this section.
 - 2. Section 210516 – Expansion Fitting and Loops for Fire Suppression Piping.

1.02 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 13 - Installation of Sprinkler Systems.

1.03 SYSTEM DESCRIPTION

- A. System to provide coverage for building areas noted.
- B. Provide hydraulically designed system to NFPA 13 light and ordinary hazard occupancy requirements.
- C. Volume and pressure of incoming water supply from hydrant flow test. See data on drawings.
- D. Interface system with building fire and smoke alarm system.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- B. Product Data: Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Samples: Submit two of each style of sprinkler specified.

- D. Design Data: Submit design calculations; signed and sealed by professional engineer.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- B. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC New Jersey Edition, Insurance Underwriters requirements and all applicable codes.
- B. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of NJ.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers until installation.
- B. Furnish piping with temporary inlet and outlet caps until installation.

1.10 EXTRA MATERIALS

- A. Furnish six extra sprinklers with cabinet of each type.
- B. Furnish suitable wrenches for each sprinkler type.

- C. Furnish metal storage cabinet in location designated.

PART 2 - PRODUCTS

2.01 SPRINKLERS

- A. Manufacturers:
 - 1. Viking.
 - 2. Automatic Sprinkler Corp.
 - 3. Fike Protection Systems.
 - 4. Grinnell Corp.
 - 5. Reliable Sprinkler Corp.
 - 6. Victaulic.
- B. Suspended Ceiling Type:
 - 1. Type: Concealed dry-type pendent with matching escutcheon plate.
 - 2. Finish: Color as selected on construction documents.
 - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Guards: Finish to match sprinkler finish.

2.02 PIPING SPECIALTIES

- A. Fire Department Connections – Existing to Remain.

2.03 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Controls: Supervisory switches.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install Work in accordance with NFPA 13 and the State of New Jersey.
- B. Place pipe runs to minimize obstruction to other work.
- C. Install piping in concealed spaces above finished ceilings.
- D. Center sprinklers in two directions in ceiling tile and install piping offsets.
- E. Install guards on sprinklers installed below 6'-8" and in locations subject to damage.

- F. Hydrostatically test entire system in new building addition, including from incoming water supply to new point of connection to the revised sprinkler system.
- G. Require test be witnessed by Authority having jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Verify signal devices are installed and connected to fire alarm system.

3.03 CLEANING

- A. Flush entire piping system of foreign matter.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

- A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting.

END OF SECTION

SECTION 220500 - GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.
- B. This Section, "220500", governs all requirements as applicable to the plumbing work specified in other Sections of Division 22.

1.2 DIVISION OF RESPONSIBILITY

- A. The requirements under Section 220500 are intended for the party or parties who have been duly awarded the applicable portion of work to be performed under the indexed sections of Division 22 also known as the Plumbing Work.

1.3 REFERENCE STANDARDS

- A. Compliance with the following codes and standards shall be required as applicable:
 - 1. IBC NJ Ed. International Building Code – NJ Edition
 - 2. NSPC National Standard Plumbing Code
 - 3. CISPI Cast Iron Soil Pipe Institute
 - 4. NEMA National Electrical Manufacturers Association
 - 5. FM Factory Mutual
 - 6. NFPA National Fire Protection Association
 - 7. ASTM American Society for Testing Materials
 - 8. UL Underwriters' Laboratories, Inc.
 - 9. NEC National Electrical Code
 - 10. ASME American Society of Mechanical Engineers
 - 11. ANSI American National Standards Institute
 - 12. OSHA Occupational Safety and Health Act
 - 13. AWWA American Water Works Association
 - 14. MSS Manufacturer's Standardization Society of the Valve and Fitting Industry
 - 15. ARI Air Conditioning and Refrigeration Institute
 - 16. ISEA Industry Safety Equipment Association
 - 17. NSF National Sanitation Foundation
 - 18. PDI Plumbing Drainage Institute
 - 19. FS Federal Specification

20.	IAMPO	International Association of Plumbing and Mechanical Officials
21.	ASSE	American Society of Sanitary Engineering
22.	DOE	United States Department of Energy
23.	EPA	United States Environmental Protection Agency
24.	IFC	International Fire Code
25.	IMC	International Mechanical Code
26.	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers

- B. Conform to materials and equipment rating standards, listings or classifications of the above organizations as well as ratings, listings or classifications accepted under local codes and laws.

1.4 ABBREVIATIONS

- A. In addition to those listed below, meanings of common abbreviations used in text of Division 22 of the Project Specifications are tabulated in ASHRAE Handbook, "Fundamentals", latest edition.

- B. Project Abbreviations:

MER	Mechanical Equipment Room
HVAC	Heating, Ventilating and Air Conditioning
BMS	Building Management System
GC	General Contractor
AC	Air Conditioning
H & V	Heating and Ventilating
AWG	American Wire Gauge
BWG	Birmingham Wire Gauge
USS	United States Standard
B & S	Brown & Sharpe
OS & Y	Outside Screw and Yoke
IBBM	Iron Body Brass Mounted
WSP	Working Steam Pressure
PSIG	Pounds per Square Inch Gauge
PRV	Pressure Reducing Valve
GPM	Gallons per Minute
MBH	Thousand BTU per hour
BTU	British Thermal Units
F	Degrees Fahrenheit
WG	Water Gage
GPM	Gallons Per Minute
#	Number
SP	Static Pressure
CFM	Cubic Feet per Minute

LB Pound (Also shown as: #)
See Drawings for additional abbreviations

1.5 DEFINITIONS

- A. "Provide" means furnish and install, complete, the specified material, equipment or other item and perform all required labor to make a finished installation.
- B. "Furnish and install" has the same meaning as given above for "Provide."
- C. "Engineer" or "Architect" means the authorized representative of the Owner.
- D. Refer to General Conditions for other definitions.

1.6 REVIEW OF CONTRACT DOCUMENTS AND SITE

- A. With the submission of his Bid, Contractor shall give written notice to the Owner of any materials or apparatus believed in-adequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice it is mutually agreed that the Contractor has included the cost of all required items in his Proposal for a complete project.
- B. Contractor shall acknowledge that he has examined the Plans, Specifications and Site, and that from his own investigations he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, water, electric power, roads and uncertainties of weather; the conformation and condition of the ground; the character, quality and quantity of surface and subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect the work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.
- C. Owner assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the

Contract, and the Contract expressly provides that the responsibility, therefore, is assumed by the Owner.

1.7 MEASUREMENTS

- A. Contractor shall base all his measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. He shall verify all measurements at site; and check the correctness of same as related to the work.

1.8 LABOR AND MATERIALS

- A. All materials and apparatus required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces.
- B. Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the Owner.

1.9 COVERING OF WORK

- A. No pipe, fitting, or other work of any kind shall be covered up or hidden from view before it has been examined or approved by the Engineer, Architect, and/or other authority having jurisdiction over same. Any unacceptable work, or unauthorized or disapproved materials discovered shall be removed and corrected immediately after being condemned.
- B. Any type of equipment shown or specified to be installed outdoors, on grade or on roof, shall have appropriate protection against outdoor weather. Equipment such as motors, panels, etc. shall have rain hood or appropriate protection as provided under Division 22. Insulated pipes shall have aluminum covers or as specified. Insulated ducts shall be provided with aluminum jacket with overlapping, sealed joints. Uninsulated ducts shall be soldered joints and seams or as specified. Where no protection is feasible, such as in exposed vibration springs, hangers, pipe or steel members, such items shall be hot dipped galvanized or as approved by the Architect.

1.10 PROTECTION

- A. Contractor shall protect the work and material of all trades from damage by his work or workmen, and shall replace all damaged material with new.

- B. Contractor shall be responsible for work and equipment until his work is finally inspected, tested, and accepted; he shall protect his work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.
- C. Contractor shall be responsible for the preservation of all public and private property, along and adjacent to the work, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and shall carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove them until directed.
- D. All mechanical and electrical equipment delivered to the site shall have appropriate wrapping to protect them from rain, flood, wind, construction debris and all types of water damage normally encountered at the construction sites. Protection of equipment such as fans, coils, valves and similar equipment shall be the responsibility of the Contractor receiving such equipment at the jobsite for installation under Division 22 Contract.

1.11 CUTTING AND PATCHING

- A. Provide all cutting and rough patching required for systems and equipment included in these specifications. All finish patching will be done under General Construction work.
- B. Furnish and locate all sleeves and inserts required before the floors and walls are built; Contractor shall pay the cost of cutting and patching required for pipes where sleeves and inserts were not installed in time, or where incorrectly located. Provide all drilling required for the installation of hangers.
- C. All holes cut through concrete slabs or arches shall be punched or drilled from the underside. No structural members shall be cut without the approval of the Architect and all such cutting shall be done in a manner directed by him.
- D. Contractor shall not do any cutting that may impair strength of building construction. No holes, except for small screws, may be drilled in beams or other structural members without obtaining prior approval. All work shall be done in a neat manner by mechanics skilled in their trades and as approved.

- E. Provide sleeves and fire stopping at piping and ductwork floor, wall and roof penetrations.

1.12 SUBMITTALS

A. Procedure:

1. Prepare a schedule of specific submissions at the outset of the Project for the Owner's review and approval; make submissions listed below and in the other Sections of Division 22 of the Project Specifications.
 - a. If submissions listed in other Sections of Division 22 are more specific than those listed below, comply with the more specific requirements.
 - b. Failure of the Contractor to submit Shop Drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of such default will be allowed.
 - c. Piecemeal submittals are unacceptable and will not be reviewed. No submittal shall be considered for review, the review of which is contingent upon acceptance of other features for which submittals have not been submitted.
 - d. Submittals from Vendor without Contractor's review and approval stamp will not be reviewed.
 - e. Submittals shall not be used by the Contractor as a means to secure approval of a substitution. Contractor must indicate all deviations, omissions and substitutions in his submittal; if there are none of these 3 exceptions, he shall then state on the submittal: "NO EXCEPTION TAKEN". Any submittal without stated exceptions, or without statement that no exception is taken will not be reviewed and will be rejected and returned to Contractor for rectification.
 - f. All products of a similar nature (i.e., valves, pipe, fixtures) shall be provided by one manufacturer.

B. Shop Drawings:

1. Manufacturer's Drawings:
 - a. Submit equipment listed in all applicable Sections - include material specifications, operating characteristics and finishes, specified agency listings or approvals.

- b. Cuts, brochures or other literature submitted for expeditious approval but incomplete or missing items of hardware or software (performance data) shall be re-submitted until all system or equipment components have been reviewed and approved. Any item not included in the original or first submission shall be considered outstanding work until such item of equipment or work has been submitted or installed in place exactly conforming to the intent of the contract documents.
- c. Contractor shall provide preliminary layout drawings (CAD Format) of all major pieces of equipment (i.e., water heaters, pumps, backflow preventers), confirming that the submitted product physically fits within the architectural enclosures. This drawing is required along with the manufacturer's product data.
- d. Contractors shall be responsible for all costs related to substitutions as they affect other contractors.

2. Installation Drawings:

- a. Furnish coordinated drawings (CAD Format) of equipment installation, including interconnecting piping and ductwork. Minimum scale for these drawings shall be 1/4 inch equals one foot for piping and 3/8 inch equals one foot for ductwork.
- b. Coordinate space requirements for electrical, HVAC and other trades in the vicinity of work.
- c. Include connections, anchorages and fastenings for piping, conduit and ductwork.
- d. Make allowance for clearances for access to and maintenance of equipment.
- e. Do not install any piping or equipment, in any area, prior to obtaining approval of its layout by means of submitting shop drawings.
- f. Any missing items of equipment, material or labor, during initial submission of shop drawings, are to be completed and re-submitted for final approval. Shop drawing should not be used as a vehicle for obtaining variances, deviation or omission from the scope of contract documents. Approval of a submittal shall pertain to the portions that conform to the intent of the contract documents.

- g. Submission of any missing, incomplete or otherwise deviant layout is subject to re-submission until all contract requirements have been properly included or shown on the same layout.
 - h. Submit drawings indicated on equipment and piping loads to structural engineer for review.
- C. Required Samples:
 - 1. Color samples, for prefinished items.
 - 2. Natural finish metals, for quality of finish.
- D. Reports:
 - 1. Compliance with listings and approvals for equipment and for fire ratings.
 - 2. Acceptance certificates from inspecting agencies.
 - 3. Complete printed and illustrated operating instructions where required in report format.
 - 4. Manufacturer's pressure tests on vessels.
 - 5. Manufacturer's performance tests on operating equipment.
 - 6. Field pipe testing reports.
 - 7. Welder's certificates and field test reports.
 - 8. Field operating test results for operating equipment.
 - 9. Performance report on the balancing of water systems.
 - 10. Performance reports for vibration isolation equipment.
 - 11. Manufacturer's reports on motorized equipment alignment and installation.
 - 12. Additional reports as noted in other sections.
- E. Specific references to any article, device, product or material, fixture or item of equipment by name, make or catalog number shall be interpreted as establishing a basis of cost and a standard quality. All devices shall be of the make and type listed by Special Agencies, such as the Underwriters' Laboratories, and where required, approved by the authority having jurisdiction.

- F. Contractor shall be responsible for any deviations in equipment size, motor horsepower and access requirement, from specified products.

1.13 COORDINATION

- A. Contractor shall prepare preliminary shop drawings (CAD format) suitable for use in coordinating his work with the work of other trades. The HVAC Section shall prepare and furnish background with ductwork at $3/8" = 1'-0"$ scale for all trades to indicate piping, cable tray and conduit in relation to all structural elements of the construction, including floor elevations; steel locations, size and elevations; partitions locations; door locations and direction of swing; and all other information required to assure coordination of the electrical, sheetmetal and piping trades and fire protection in relation to the Architectural function of the project. Coordination meetings shall be held under the supervision of the General Contractor (GC). Each trade shall have proper representation at all coordination meetings for the purpose of detailing, on the drawings mentioned above, the exact location and routing of their work. After the conclusion of the coordination at the working meetings, each trade shall sign the coordinated originals, copies of which shall be distributed by the GC to all parties concerned including the Owner. Final shop drawings of all trades shall be in accordance with the coordinated drawing, after which final shop drawings shall be submitted for final approval.
- B. If the trade contractor installs work so as to cause interference with work of other trades, he shall make necessary changes in work to correct the condition immediately without delaying project and without extra charge.
- C. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for mechanical equipment. Include dimensions of bases, bolt layouts, details, etc.
- D. Contractor shall furnish all necessary templates, patterns, etc., for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

1.14 EXCAVATION AND BACKFILLING

- A. Excavation and backfilling of trenches required for the installation of all services underground piping and underground tanks inside and outside of the building are to be provided by each respective Section involved.
- B. Trenching: Excavate to required depth and grade, the bottom of trenches to secure required slope for pipe lines. Each trade will be responsible for the required slopes, inverts, bed material, and all other pertinent requirements.

- C. Bottom of trench shall be accurately excavated to provide firm, uniform bearing for bottom of the pipe. Pipe having bells, sleeves or other enlargement at joints to have recesses excavated to accommodate these joints.
- D. Backfilling: Trenches shall not be backfilled until piping has been tested. Backfill consisting of sand or selected excavated material shall be placed to a level equal to the final grade and hand compacted as required to produce the same density as the soil in the surrounding areas. Furnish and run constantly, if required or directed, sufficient pumping machinery to keep trenches free from water up to the time of inspection and acceptance of that part of this work.
- E. Refer to General Conditions for additional requirements governing excavation and backfilling. These requirements shall prevail unless superseded by specific requirements in Division 22.
- F. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be approved before work commences. Each Trade Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.
- G. Provide sheet piling where required to properly support sides of trenches and excavations.

1.15 CONCRETE AND GROUTING

- A. Requirements for concrete and grouting are specified in other Sections.
 - 1. Concrete shall be 3,000 psi stone concrete with water reducing admixture, except where otherwise specified.
 - 2. Concrete shall have air entraining admixture where exposed to weather.
- B. Contractor shall make coordinated layouts showing concrete work required for housekeeping pads, roof curbs, thrust blocks, etc. which are cast in place.
- C. Concrete housekeeping pads: 4" minimum thickness, sized to cover the full area of each piece of equipment and access area provided under Concrete Work.
- D. Concrete bases: Dimension and height to suit the equipment.
- E. Concrete inertia blocks for vibration isolation. Dimensions designed by the vibration isolation equipment manufacturer and inertia block provided by Division 22, under Mechanical work.

- F. Outside the building all concrete work related to mechanical equipment shall be provided by the Trade Contractor of Division 22, unless otherwise noted in the Contract Documents.

1.16 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

- A. Noise levels from operation of motor driven equipment, whether airborne or structure-borne, and noise levels created by or within plumbing equipment are not to exceed sound pressure levels determined by the noise criteria curves in the ASHRAE Guide and as noted under Section 22 05 48.
- B. Acoustical Tests:
 - 1. Owner may require contractor to conduct sound tests for those areas or equipment he deems too noisy.
 - 2. If NC level in any space exceeds that in the schedule or the specification due to improper installation or operation of mechanical systems, the respective Trade Contractor is required to make remedial changes or repairs.
 - 3. Respective Trade Contractor is required to retest until specified criteria has been met.

1.17 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Instructions and Demonstration for Owner's Personnel:
 - 1. After all equipment is functioning properly, each system is to be automatically operated for ten (10) working shifts, and not to be adjusted during this period, 80 hours in heating and 80 hours in cooling seasons, scheduled at the convenience of the Owner. Any adjustments will void the test and start the time period all over again.
 - 2. The hours of operation are to include the Owner's designated personnel in each shift, for each season.
 - 3. During this period, instruct the Owner's personnel in the use, operation and maintenance of all equipment of each system. Training will include a lecture-type instruction given in a non-machine room environment. During the lesson, normal operation of the system installed and operating will be explained, along with troubleshooting procedures. This will be followed by a field inspection and demonstration of equipment.

4. The above instruction is exclusive of that required of specified equipment manufacturers. If more stringent or longer instruction is indicated for specific equipment or systems, these shall supersede the above requirements.

B. Operating and Maintenance Data:

1. Provide four (4) complete sets of manufacturer's catalogues, instructions, maintenance and repair information and parts lists for operating equipment and devices.
 - a. Include performance curves for fans and pumps, factory furnished wiring diagrams and control diagrams, and applicable flow diagrams.
 - b. Submit seven sets of instructions for distribution.
2. Data for the equipment actually installed is to be submitted.
3. The data is to be carefully checked for accuracy by comparison with the installed equipment nameplates.
4. Provide a recommended list of spare parts for equipment and list of special, non-standard tools to service equipment.
5. Index and assemble the instructions in durable loose-leaf binders.
6. The completed binders are to be available at the time the equipment installation begins.
7. In addition, follow all requirements of Section 01 77 00 "Execution and Closeout Requirement".

1.18 RECORD DRAWINGS

- A. Provide and maintain a currently up-to-date record set of reproducible prints showing all changes, additions or omissions made during construction. Contractor shall, at his own expense, produce the Record Drawings.
- B. Deliver four (4) sets of all as-built drawings and one (1) set of reproducible drawings of the record drawings to the Owner before submitting requisition for final payment.
- C. Shop Drawings shall be cross-referenced on the Mylar copies for this requirement where applicable.
- D. Submit AutoCAD compatible as-built drawing files.

1.19 WARRANTY

- A. The following supplements the GENERAL CONDITIONS for Plumbing Work:
 - 1. Non-durable, expendable items such as replaceable (not cleanable) water filter media are not subject to replacement after the date of acceptance.
 - 2. Warranty time limits for equipment exceeding those indicated in GENERAL CONDITIONS are specified in the applicable Sections of Division 22.
 - 3. In addition, follow all requirements of Section 01 77 00 "Execution and Closeout Requirement".

PART 2 PRODUCTS

2.1 IDENTIFICATION MARKINGS

- A. Every valve, control, and apparatus installed under this Contract shall be tagged, labeled or stenciled as follows: Tags and labels securely fastened by brass chains, screws or mastic as applicable. Equipment controls numbered according to equipment schedules on Plans. Tags numbered to conform to a directory listing number, location and use. Directories to be mounted under glass in aluminum self-closing frames, 8-1/2" x 11" in size.
 - 1. Apply identification after testing, insulation and field painting are completed.
- B. Valve Identification:
 - 1. Provide an identification tag for each valve, including control valves.
 - 2. Differentiate between the different classes of service in the numbering systems.
 - 3. Use 2" brass tags stamped with 3/16" top hole, 1/4" letters above 1/2" numbers, filled in with black enamel.
 - 4. Attach tags securely to handles or spindles of valves with heavy brass "S" hooks or brass chains.
 - 5. Provide six copies of valve charts with one of each framed under glass and mounted where directed.
- C. Piping Identification:

1. Provide on bare and covered pipes for all services.
2. Use a system of marking and colors conforming to ANSI A-13.1.
3. Provide "snap around" or "strap around" type depending on pipe size.
4. Install in readily visible location.
5. Apply legend and flow markers as required for maintenance purposes, with at least one marker in every 50'-0" of each line and at every change of direction.
6. Color Coding of Piping: Specify that, after piping has been finish painted, the installer of the piping shall identify the type of service lines with applied color bands. The direction of flow shall be indicated with stenciled arrows. Color bands shall be 1-inch wide, finished in gloss enamel; lettering and arrows shall be same color as the bands. Specify that indicators be applied at connections to pumps, chillers, and other equipment; at entrances to spaces; adjacent to valves; near access doors to pipe spaces; and at maximum intervals of 50 feet on long pipe runs. Specify that letters be positioned to be easily read from a normal standing position. If there is no owner's standard for color code and designation, the following colors and letter designations shall be used:

PLUMBING PIPING

Service	Color	Designation
Natural Gas	Yellow	Natural Gas
Cold water	Green	Cold Water
Hot water	Yellow	Domestic hot water
Hot water return	Yellow	Domestic hot water return
Non-potable water	Yellow	Non-potable
Sanitary	Green	Sanitary sewer
Vent	Yellow	Vent
Rain water	Green	Storm sewer
Pump discharge	Green	Pump discharge
Cold water	Green	Tank fill

D. Equipment Identification:

1. Provide stencil lettering on operating equipment and units:
 - a. Use black oil base paint, except where equipment finish is dark, use white paint.

- b. Make all characters distinguishable from the floor, but not less than 2" high.
 - 2. For each motor starter, controller and similar accessory provide a lamcore nameplate attached with screws or rivets to a fixed part of the equipment in a visible location.
 - a. Make plates not less than 2" x 1" x 1/8" thick with 1/4" high characters.
 - 3. Equipment such as tanks, access doors to equipment such as filters, neatly stenciled with letters not less than 1 inch high. Any equipment too small to receive such stenciling shall be provided with brass name tags 2" x 1" in size.
 - 4. In areas where removable ceilings occur, install appropriate color coded tile markers to indicate location of valves and other equipment or fittings that may require maintenance service.
- E. Refer to Section 22 05 53 for additional requirements.

2.2 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Keep piping 2'-0" outside the vertical line of unprotected electrical equipment or provide non-corrosive metal (soldered 20 gauge copper or welded stainless steel), watertight support, pans piped to an open drain.
- 1. Construct and support pans to hold minimum depth of 3 inches of water.

2.3 ACCESS DOORS

- A. General:
- 1. Steel, flush four-sided frame and door assembly, chemically cleaned after fabrication and painted with rust inhibitive primer.
 - 2. Provide hardware and locking devices.
 - 3. Provide access doors required for access to mechanical work through finished wall construction and non-removable ceiling construction.
 - 4. Deliver doors and location information to appropriate trade for installation.
- B. Furnish for installation by the appropriate trade, flush type access door or panel no smaller than 18" x 18" and no larger than 30" x 30" for all valves, cleanouts, or apparatus located in chases, walls, non-accessible hung

ceilings or floors; finish shall be prime coat, except floor panels which shall be polished brass or chrome plate. Doors and trim 14 gauge steel, frame 16 gauge steel, with flush concealed and standard flush locks, screwdriver operated cams, of Milcor manufacturer or approved equal.

1. All panels and their exact location subject to approval of the Architect.
2. Where space conditions prevent door swinging open, provide removable door on lift-up hinges. This will only be accepted on a case-by-case basis. This condition must be submitted to the Owner and Engineer for approval prior to installation.
3. Furnish a complete list locating all access doors required in finished walls, ceilings, partitions, shafts and other inaccessible locations.

2.4 PRIME PAINTING

- A. All piping, supports, auxiliary steel and miscellaneous iron within all MER's shall be prime painted as specified herein.
- B. All exposed uninsulated piping, fittings, equipment stands, supports, platforms, cradles, and hangers; except chrome finished materials, shall be painted. All ungalvanized surfaces shall be painted with zinc chromate, or approved equal, and all galvanized surfaces shall be prime coated with a phosphate pretreatment coating, dry film thickness of 0.35 with a 0.50 mil. one coat Glid-Guard galvanized steel primer Y5229, or approved equal.
- C. Upon completion of the prime coat of all mechanical equipment specified above, all insulated and exposed piping shall be painted with finish coating, as specified under Division 09 90 00 and/or other Sections. This Section shall complete stenciling and color identification, specified under Division 22, following the finish painting.
- D. Except where otherwise specified, steel piping in concrete and buried steel piping and steel tanks:
 1. Provide heavy coat of bituminous solution primer.
 2. In accordance with NFPA and other applicable codes.
- E. Provide factory finishes, except as noted, to match Architect's color samples, for items appearing in exposed finished work, and including:
 1. Equipment
 2. Enclosures on equipment

- F. All damaged factory painted surfaces shall be repaired to match original surface. If, in opinion of Owner, such repairs are unsatisfactory, item in question shall be completely refinished or replaced with new.

2.5 WELDING

A. General:

1. All welding procedures, welders, and welding operators shall be qualified in accordance with the requirements of ASME/ANSI B31.9 and Section IX of the ASME Code, latest editions.
2. Welding procedures shall be reported on ASME Section IX Forms "QW," or its equivalent. Joint preparation sketches (to be included with the welding procedures) shall show all dimensions including tolerances, for bevel angle, land size, offset and root gap.
3. Contractor shall be responsible for the welding performed by personnel of his organization and shall conduct the required qualification tests and submit results to the Owner for his review and approval.
4. All welding procedures shall meet requirements of the local authority having jurisdiction. The filing of MSDS form shall be held in the field office.
5. A copy of the welders and fire watch certificate shall be held in the field office of the sight.

B. Processes:

1. Employ the Manual Shielded Metal-Arc (SMAW) welding process.
2. Double butt welding shall be permitted on all joints accessible from both sides. Where double butt-welding is employed, the first root pass shall be back-chipped.
3. Welding of pressure parts shall be performed with low hydrogen type electrodes. Electrodes of Classifications E6012, E6013, E7014 and E7024 shall not be used.
4. Brazing and Soldering:
 - a. The Contractor shall prepare applicable "Brazing and Soldering Procedures" forms for approval of the Owner.
 - b. Brazing shall conform to ASME Section IX.

- c. Soldering shall conform to the relevant procedures in the manuals of the Copper Development Association.
 - d. For all refrigeration piping, the mechanics shall be skilled and specially trained in this type of pipe joining.
 - e. The Owner may reject any brazed or soldered joint for lack of penetration or for other applicable grounds. These defective joints shall be redone until satisfactory.
- C. Quality of Workmanship - In addition to conformance with the procedural and quality requirements set forth in the applicable Code or material specification, all welding shall meet the following requirements.
- 1. Butt welds shall have full penetrations and shall be slightly convex with uniform height.
 - 2. Each weld shall be uniform in width and size throughout its full length.
 - 3. Each layer of welding shall be smooth, free of slag, cracks, and pinholes, undercut in excess of 1/32" and completely fused to adjacent weld beads and base metal.
 - 4. Cover passes shall be free of coarse ripples, irregular surface, non-uniform bead patterns, high crown, and deep ridges or valleys between heads. The surface smoothness of the finished weld shall be suitable for the proper interpretation of non-destructive examination of the weld.
 - 5. Surfaces of parts to be joined by welding shall be cleaned of all oil, grease, paint, scale and rust with solvent and/or wire brushing.
 - 6. Fillet weld size shall be in accordance with the applicable code or as specified on the drawings with full throat and legs of equal length.
 - 7. Welding filler metal and welding flux shall be properly stored in such a manner as to insure that no damage to the coating or corrosion of weld rod will occur. Low hydrogen type electrodes shall be stored in enclosures which provide a regulated temperature as prescribed by the electrode manufacturer. All electrodes shall be properly identified.
 - 8. Socket welds shall have a gap of approximately 1/16" between the bottom of the socket and the end of the pipe prior to welding. Socket welds shall have a minimum of two weld layers.

9. Welds for steam piping shall be X-rayed in accordance with IBC requirements. Submit results of X-ray analysis for approval.

D. Repair and Weld Defects:

1. A weld is defective and shall be repaired if it does not meet the acceptance standard of each applicable non-destructive examination as defined ASME/ANSI B31.9, latest edition.
2. Repairs shall be made in accordance with ASME/ANSI B31.9, latest edition.

E. Welding Identification and Weld Marking:

1. All welds must be identified with the welder's identifying symbol. Welds, where more than one welder performs the work, shall be stamped by each welder.
2. Marking shall be done by a permanent method that will not result in sharp discontinuities.
3. Where stamping or marking on the base materials is not practical or feasible, permanently affixed metal bands of the same material may be applied. Stamping or any method of permanent marking on the bands is acceptable.

2.6 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled, and as specified.
- B. Equipment of other manufacturers will be considered, subject to its acceptability and the following:
 1. The equipment must conform to the structural design provisions for loads applied to the structure; to the dimensions established by drawings for spaces and other (service, etc.) clearances; and for inlet and outlet locations and relationships to associated equipment and piping.
 2. Changes to the building arrangement or structure, which are required to suit equipment offered must be by the Contractor at no extra expense to the Owner.
 3. Changes to the electrical requirements such as circuit breaker or starter size, conduit or wire size shall be coordinated by the Contractor and the expense borne by him with no additional cost to the Owner.

4. Changes to other Contractor's scope of work shall be the responsibility of this Contractor, at no extra expense to the Owner.
- C. Operating equipment, operating systems and other products are specified by names and models and also by performance criteria standards:
1. Where both specifying media are employed, the names and models establish a standard for manufacturing quality, while the performance criteria governs the capacity, rating or output.
 2. In any question regarding intent, the capacity, rating or output which is compatible with the other systems, is intended to be of prime concern and is to be provided.
 3. Contractor shall follow Owner's Standards for Turn-Over Acceptance, Commissioning and Testing. Where there is a conflict between these requirements and Building Department's requirements, the more stringent requirements shall apply.
- D. The descriptions of equipment and systems cover basic equipment and operation, but not all the details of design and construction.
1. The use of singular in descriptions does not limit the quantities to be furnished to produce the complete system, together with the results specified.
 2. Furnish equipment required to provide specified performance under installed conditions.
 3. Factory wiring and piping is to conform to specifications for field work, unless otherwise specified.
 4. Provide trim, enclosures, transition pieces and accessories required to make complete installation in each instance.
- E. All Mechanical Drawings of Division 22 are schematic and diagrammatic.
1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but they do not necessarily have dimensional significance, neither do they necessarily include all related and subsidiary parts and equipment. Contractor shall provide all parts, elements, transition pieces, etc. as required for a complete and operational system.
 2. The work is to be installed complete and ready for operation in conformity with the intent expressed on the Drawings and in the Specifications.

3. Coordinate work with the requirements of the Architectural and Structural drawings for dimensions, locations and clearances.
4. Locations of mechanical and electrical items which are exposed to view shall be taken from the Architectural Drawings where available, or are to be located as directed by the Architect.
5. Contractor shall provide all transition pieces and rises/drops for piping.
6. Minimum height of piping, valves, etc. in mechanical rooms excluding drops to equipment, shall be 7'-0" unless otherwise noted.

2.7 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for equipment requiring them.
 1. Level and shim the equipment; coordinate and oversee the grouting work.
 2. After one week of continuous operation, the technician will return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.
- B. Field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspection, adjustments and approval by the manufacturer, as a part of the Contract.
- C. Alignment and Lubrication Certification for Motor Driven Apparatus:
 1. After permanent installation has been made and connections have been completed, but before the equipment is continuously operated, a qualified representative of the manufacturer is to inspect the installation and shall report in writing on the manufacturer's letterhead as follows:
 - a. That shafts, bearings, seals, couplings, and belt drives are perfectly aligned and doweled so the equipment will remain perfectly aligned in the normal service intended by the Documents and that no strain or distortion will occur in normal service. All dowels shall be aligned after equipment is running.
 - b. That all parts of the apparatus are properly lubricated for operation.

- c. That the installation is in accordance with manufacturer's instructions.
- d. That suitable maintenance and operating instructions have been provided for the Owner's use.

D. Belt Drives:

- 1. V-belt drives shall include a driving and driven sheave grooved for belts of trapezoidal cross-section. Belts shall be constructed of fabric and rubber so designed as not to touch the bottom of the grooves, the power being transmitted by the contact between the belts and V-shape groove sides. Drives shall be designed for a minimum of 150 percent of motor horsepower. Drive sheaves shall be of the companion type.
- 2. All motors shall be provided with fixed sheaves, once the correct speed is determined during testing/balancing period.
- 3. All fans shall be installed with fixed pitch sheaves on their drive motors. Sheaves shall be selected to provide air quantities under specified conditions. Air systems shall be put into operation, and Contractor shall determine actual size of sheaves required to produce specified air quantities on installed systems via the use of adjustable sheaves. Adjustable pitch sheaves shall then be replaced with the proper size fixed sheave. Adjustable pitch sheaves shall be property of Contractor and removed from premises.

E. Machinery Guards:

- 1. Motor drives shall be protected by belt guards furnished by the equipment manufacturer or in accordance with the Sheet Metal and Air Conditioning Contractors National Association's Duct Manual. In all cases, guards of all types must be as approved as acceptable under OSHA Standards.

F. Equipment Startup:

- 1. Each equipment manufacturer is to provide qualified personnel to inspect and approve equipment and installation and to supervise the startup of the equipment and to supervise the operating tests of the equipment.
- 2. If a minimum number of hours for startup and instruction are not stated with the equipment specifications, these shall be 2 full 8-hour working days as a minimum.

3. Advise Owner of startup at least 72 hours in advance.

G. Equipment Turn-Over:

1. Contractor shall follow Owner's Standards for Turn-Over Acceptance, Commissioning and Testing. Where there is a conflict between these requirements and the regulations by commissioning agent, the more stringent requirements shall apply.

2.8 CLEANING AND ADJUSTING

A. Notification:

1. Inform owner and architect's field representatives of all cleaning, blowing out and fill-up schedules one week prior to starting.
2. Notify owner and architect again, 48-hours prior to each event. If neither attends the procedures, notify in writing, the specific task performed 24-hours after each event.
3. Leaks appearing during the various pressure tests shall be corrected by replacing all defective materials or welds and subsequent tests shall not be made until the piping is found in perfect condition. Caulking of screwed joints or peening of welds is prohibited. Wherever it is necessary to cut out a weld and the ends of the pipe cannot be conveniently brought together, then a short piece shall be fitted in and welded.
4. Damage to the building and equipment resulting from tests shall be repaired at no additional cost to the Owner.
5. Tests claimed to have been performed without following above procedures shall be deemed as not performed.

B. Cleaning:

1. Blow out, clean and flush each piping system and equipment, to clean thoroughly. MSDS forms for clean agent and procedure shall be presented to the field office. After cleaning, the systems shall be tested by an independent organization, approved by Owner's representative prior to testing.
2. Clean all materials and equipment; leave in condition ready to operate and ready to receive succeeding finishes where required.
3. Clean the operating equipment and systems to be dust free inside and out.

4. Clean concealed and unoccupied areas such as plenums and pipe spaces and equipment rooms to be free of rubbish and dust.
5. After completion of all pressure tests, properly clean every piece of apparatus furnished and remove caps and other provisions made for testing purposes only.
6. Cutting oil, excess pipe joint compound, finely divided solids and other similar foreign material shall be removed from all circulating water systems before they go into operation. Before chemical cleaning of water systems flush with clean water. Each system shall be cleaned chemically with circulating solution as specified in section 22 25 00. Fill, vent and circulate the system with this solution at maximum operating temperature for required duration. During cleaning procedure, circulation shall be stopped periodically followed by blow off at all low points. Immediately following chemical cleaning, system to be drained and then refilled with clean water to which treatment shall then be added. After systems have been drained, flushed and refilled, a chemical test shall be made to determine that the cleaning solution remaining in the system does not impart alkalinity to the water in excess of 300 ppm.
7. After the water piping system has been properly cleaned as indicated above, each water system shall be operated for a minimum of 3 days with 1/2" surgical felt, bonded to baskets on each pump strainer. Felt filters shall be run for as long a time as necessary to thoroughly clean all piping until approved by Owner's representative. During the cleaning period, heat exchangers and coil valves shall be kept closed for the entire cleaning period. Provide one (1) inch manual bypass at equipment to permit flushing of branch piping. For flushing and blow-off for main risers, provide drain valves at the bottom in the horizontal run out to the riser. Also provide an additional valve in the cyclo-clean separator piping for pumps with mechanical seals so that separator discharge water may be wasted during the cleaning procedure.
8. All pipe strainers shall be removed and cleaned upon completion of blowdown period.
9. After this period of operation, all systems shall be drained and refilled with fresh water as specified.
10. All equipment installed shall be thoroughly cleaned in preparation of the finished painting.
11. All dowels shall be aligned after system is running.

C. Adjusting:

1. Adjust and align equipment interconnected with couplings or belts. After one week of continuous operation, the technician will return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.
2. Adjust valves of all types and calibrate equipment of all types to provide proper operation.
3. Clean all strainers after system cleaning and flushing and again before final system startup.
4. Motors, fans, pumps, compressors, etc. shall be properly oiled and left ready for operation.
5. Verify that each and every supply and return and exhaust fan, each fan coil unit fan, motor and automatic control valve is in running condition. All equipment shall be cleaned, including coils, motors, housing, pans, etc. and inspected by the Owner's representative.
6. Submission of certified tests shall, in no way, relieve the Contractor of fulfillment of guarantee.
7. Gauges, instruments, thermometers and meters shall be checked and tested to specified accuracy.
8. Alarms shall be tested to fulfill satisfactory operating conditions.
9. Allow sufficient time to perform all tests, adjustments, etc., necessary to place the various systems in final operating condition, verify performance requirements and check all safety devices. Labor, instruments, etc., required for various tests shall be furnished by Contractor. The Contractor shall see that all his Sub-Contractors, manufacturer's representatives or Field Engineers necessary to check and adjust various systems are present, with sufficient forms, and that all test results are recorded properly and turned over to Owner for approval.
10. The Owner's representative will make final check for all systems only after Contractor has completed and returned to the Owner all recorded test data together with letter that his work is 100% complete. Additional tests may be required to meet the requirements of Owner's documents for demonstration of various systems, whether or not specified, to verify performance, workmanship or for adjustments.

11. Unless otherwise specified, equipment shall be installed and adjusted in accordance with manufacturer's recommendations to function properly with capacities required or specified.

D. Running Test of Piping Systems:

1. Any section of the work, after it has been completed and otherwise satisfactorily tested, shall be put in actual operation by Contractor and operated by him for a period of 2 days of 24 hours each, during which time any defects which may appear shall be remedied and any necessary adjustments shall be made. Test shall be performed in the presence of the Owner or his representative, and serve as part of the Instructions Program.
2. During the time of the tests, repack all valves, make all adjustments and otherwise put the apparatus in perfect condition for operation, and shall instruct the Owner's authorized personnel in the use of management of the apparatus. All joints shall be made absolutely tight under tests. Caulking of pipe joints or makeshift methods of repairing leaks shall not be allowed. Piping which is not tight under tests shall be taken down and reassembled.
3. All gauges, thermometers, alarms, instruments, etc. shall be tested to demonstrate that they are functioning properly and within the range of these devices, and to show their degree of accuracy.
4. If during the first test run, the system cannot be completely vented within 24 hours, install additional air vents at high points of system to facilitate quick venting of all water systems.

E. Permanent Equipment Operating During Construction:

1. Use only in same service as the permanent applications, provided that written approval is granted by Owner's representative.
2. Use disposable filters during temporary operation.
3. Expendable media, including belts used for temporary operation and similar materials are to be replaced just prior to acceptance.
4. Packing's in equipment operated during construction must be repacked just prior to system acceptance, using materials and methods specified by the supplying manufacturer.

F. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

G. Tools:

1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.
- H. Pump Characteristic Charts:
1. Pump Characteristic Charts: Furnish 4 characteristic charts for each pump. Charts shall be not less than 8-1/2" x 11" showing head developed, efficiency and power required for varying capacities at the operating speed of the equipment.

PART 3 EXECUTION

3.1 GENERAL

- A. Temporary Protection:
1. Provide and maintain protection for the work whether completed or in progress.
 2. Provide suitable coverings and enclosures.
- B. Scaffolding, Rigging and Hoisting:
1. Provide all scaffolding, rigging and hoisting services necessary for erection, and/or delivery into the premises, of any equipment and apparatus furnished. Remove from the premises when no longer required.
- C. Waterproofing:
1. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect before work is done. This Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

3.2 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

- A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus requiring access for service and maintenance.
- B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding will be permitted only when approved by the Architect or the Structural Engineer.

- C. Submit shop drawings of supports for approval to the Architect before fabricating or constructing.
- D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.
- E. Where supports are on concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.

3.3 ACCESSIBILITY

- A. The installation of valves, dampers and other items shall be conveniently and accessibly located with reference to the finished building floors, walls, roof and penthouses as applicable.
- B. In-line pumps shall not be installed higher than 7 ft. above floor and shall be fully accessible for servicing its motor, valves, controls and instruments.
- C. Equipment removal, tube-pull access door swing spaces shall be identified on shop drawings and maintained during installation.

3.4 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof, for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Use of permanent equipment for temporary services must be approved in writing by Owner.

3.5 CODES, RULES, PERMITS & FEES

- A. The Contractor shall give all necessary notices, obtain all permits and filings and pay all government sales taxes, fees, and other costs, in connection with his work. However, all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity shall be paid directly to utility companies and/or agencies by the Owner, unless otherwise indicated. The Contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Owner's Representative before request for acceptance and final payment for the work.

- B. The complete design and construction shall conform to the requirements of the any other local or state code which may govern.
- C. Provide all permits as required.

3.6 FINAL INSPECTION

- A. Contractor shall arrange and schedule final inspection of work and shall notify the Architect in writing that the Contractor has thoroughly checked his work and, in the opinion of the Contractor, is ready for final inspection.
- B. During the entire period schedule for these inspections, the Contractor and representatives of each manufacturer of equipment involved shall be present. All of these organizations shall have sufficient and competent personnel present so that adjustments can be made to all systems without delay.

3.7 ACCEPTANCE

- A. The operation or the temporary use of the equipment and the mechanical and electrical installation, by the Owner does not constitute an acceptance of the work. The final acceptance is to be made after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the Contract Documents, and has furnished all the required Certificates. Warranties and guaranties are effective after the acceptance.

END OF SECTION

SECTION 220503 - PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for pipe and pipe fittings in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
1. Domestic water piping within 5 feet of building.
 2. Sanitary sewer piping within 5 feet of building.
 3. Equipment drains and overflows.
 4. Unions and flanges.
 5. Underground pipe markers.
 6. Bedding and cover materials.
- B. Related Sections:
1. Section 230500 – General Mechanical Requirements.
 2. Section 220516 - Expansion Fittings and Loops for Plumbing Piping: Product requirements for piping expansion compensation devices for placement by this section.
 3. Section 220523 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
 4. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports [and firestopping] for placement by this section.
 5. Section 230548 – Vibration and Seismic Controls for Plumbing Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
 6. Section 220700 - Plumbing Insulation: Product requirements for piping insulation for placement by this section.
 7. Section 231123 – Facility Natural Gas Piping.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.3 - Malleable Iron Threaded Fittings.
3. ASME B16.4 - Gray Iron Threaded Fittings.
4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
5. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
9. ASME B31.9 - Building Services Piping.
10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
11. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.

7. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
 8. ASTM B32 - Standard Specification for Solder Metal.
 9. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 10. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 11. ASTM B75 - Standard Specification for Seamless Copper Tube.
 12. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).
 13. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 14. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
 15. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 16. ASTM B251M - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric).
 17. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 18. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.
- B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- C. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with IBC – New Jersey Edition.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience approved by manufacturer.
- C. Design pipe hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 COORDINATION

- A. Coordinate installation of buried piping with trenching.

PART 2 - PRODUCTS

2.01 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88 (ASTM B88M), Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: lead free, [ASTM B32,] 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Soil Pipe: ASTM A74, extra heavy weight, bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

2.03 SANITARY SEWER, STORM, LEADER, VENT, HOUSE DRAIN PIPING, ABOVE GRADE, Concealed between walls of a pipe chase, within partitions, or within pipe shafts.

- A. Cast Iron Pipe: ASTM A74, service weight bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Lead and oakum packing caulked molten lead in one continuous pour.

2.04 SANITARY SEWER, STORM, LEADER, VENT, HOUSE DRAIN PIPING, ABOVE GRADE In Building Concealed above accessible drop ceiling.

- A. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.05 SANITARY SEWER, STORM, LEADER, VENT, HOUSE DRAIN PIPING, ABOVE GRADE EXPOSED IN AND OUTSIDE OF BUILDING

- A. Cast Iron Pipe: ASTM A74, extra heavy weight, bell and spigot ends.

1. Fittings: Cast iron, ASTM A74.
2. Joints: Lead and oakum packing caulked molten lead in one continuous pour.

2.06 SANITARY SEWER, STORM, LEADER, VENT, HOUSE DRAIN PIPING, BELOW GRADE UNDER BUILDING

A. Cast Iron Pipe: ASTM A74, extra heavy weight, bell and spigot ends.

1. Fittings: Cast iron, ASTM A74.
2. Joints: Lead and oakum packing caulked molten lead in one continuous pour.

2.07 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

B. Copper Tubing: ASTM B88 (ASTM B88M), Type L hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, [ASTM B32,] 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.08 UNIONS AND FLANGES

A. Unions for Pipe 2 inches (50 mm) and Smaller:

1. Ferrous Piping: Class 250, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 250, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.09 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type A as specified in Section 312300.
- B. Cover: Fill Type A, as specified in Section 312300.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1, as specified in Section 310516. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.
- B. Verify trenches are ready to receive piping.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 3 ft. of cover.
- C. Establish minimum separation of 12 ft. from other services.
- D. Install pipe to elevation as indicated on Drawings.
- E. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density.
- F. Install pipe on prepared bedding.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.

- I. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.
- J. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 312300.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.
- K. Install Work in accordance with IBC – New Jersey Edition.

3.04 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Provide pipe sleeve passing through partitions, walls and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with general construction work.
- H. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- I. Establish invert elevations, slopes for drainage to ¼ inch per foot minimum. Maintain gradients.
- J. Slope piping and arrange systems to drain at low points.

- K. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- L. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- M. Install valves in accordance with Section 220523.
- N. Insulate piping.
- O. Install pipe identification in accordance with Section 22 05 53.

3.05 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

- A. Install domestic water piping system in accordance with ASME B31.9.

3.06 INSTALLATION - SANITARY WASTE AND VENT PIPING SYSTEMS

- A. Install sanitary waste and vent piping systems in accordance with ASME B31.9.
- B. Install bell and spigot pipe with bell end upstream.
- C. Support cast iron drainage piping at every joint.

3.07 FIELD QUALITY CONTROL

- A. Test domestic water piping system in accordance with IBC – New Jersey Edition.
- B. Test sanitary waste and vent piping system in accordance with IBC – New Jersey Edition.
- C. Test storm drainage piping system in accordance with IBC – New Jersey Edition.

3.08 CLEANING

- A. Clean and disinfect domestic water distribution system.

END OF SECTION

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for expansion fittings and loops for plumbing piping. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Flexible pipe connectors.
 - 2. Expansion joints.
 - 3. Expansion compensators.
 - 4. Pipe alignment guides.
 - 5. Swivel joints.
 - 6. Pipe anchors.
- B. Related Sections:
 - 1. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for piping hangers and supports.
 - 2. Section 221113 - Facility Water Distribution: Piping.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.9 - Building Services Piping.
 - 2. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.

1.03 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees F (10 degrees C).
 - 2. Domestic Hot Water: 140 degrees F (60 degrees C).
 - 3. Safety Factor: 30 percent.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Samples: Submit two (2) low-pressure compensators for each size.
- D. Design Data: Indicate criteria and show calculations. [Submit [sizing methods] [calculations] sealed by a registered professional engineer.]
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.
- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with IBC – New Jersey Edition.
- C. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by the manufacturer.
- C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location in the State of New York.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

- A. Provide warranty data sheets.

1.11 EXTRA MATERIALS

- A. Supply two (2) 12 ounce containers of packing lubricant and cartridge style grease gun.

PART 2 - PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS

- A. Steel Piping:
 - 1. Inner Hose: Stainless Steel.
 - 2. Exterior Sleeve: Double braided stainless steel.
 - 3. Pressure Rating: 200 psig and 250 degrees F.
 - 4. Joint: Flanged.
 - 5. Size: Use pipe-sized units.
 - 6. Maximum offset: 1 inch on each side of installed center line.
- B. Copper Piping:
 - 1. Inner Hose: Bronze
 - 2. Exterior Sleeve: Braided bronze.
 - 3. Pressure Rating: 200 psig and 250 degrees F.
 - 4. Joint: Flanged.
 - 5. Size: Use pipe sized units.
 - 6. Maximum offset: 1 inch on each side of installed center line

2.02 EXPANSION JOINTS

- A. Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig and 250 degrees F.
 - 2. Maximum Compression: 3 inch.
 - 3. Maximum Extension: 1/4 inch.
 - 4. Joint: As specified for pipe joints.
 - 5. Application: Steel piping 3 inch and smaller.

- B. External Ring Controlled Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig and 250 degrees F.
 - 2. Maximum Compression: 1-1/4 inch.
 - 3. Maximum Extension: 5/16 inch.
 - 4. Maximum Offset: 1/8 inch.
 - 5. Joint: Flanged.
 - 6. Accessories: Internal flow liner.
 - 7. Application: Steel piping 3 inch and larger.
- C. Two-ply Bronze Bellows Type:
 - 1. Construction: Bronze with anti-torque device, limit stops, internal guides.
 - 2. Pressure Rating: 200 psi and 250 degrees F.
 - 3. Maximum Compression: 3 inch.
 - 4. Maximum Extension: 1/4 inch.
 - 5. Joint: Flanged.
 - 6. Application: Copper piping.
- D. Stainless Steel Bellows Expansion joints for Generator Piping:
 - 1. Pressure Rating: 300 psi suitable for 1200°F exhaust temperature.
 - 2. Maximum compression: 4".
 - 3. Joint: Flanged.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

- D. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.
- E. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 220529 for pipe hanger installation requirements.
- F. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- G. Provide expansion loops as indicated on Drawings.
- H. Install Work in accordance with IBC – New Jersey Edition.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for general-duty valves for plumbing piping. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Gate valves.
 - 2. Ball valves.
 - 3. Check valves.
- B. Related Sections:
 - 1. Section 230500 – General Mechanical Requirements.
 - 2. Section 220503 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 3. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for pipe hangers and supports.
 - 4. Section 220700 - Plumbing Insulation: Product and installation requirements for insulation for valves.
 - 5. Section 221116 - Facility Water Distribution Piping: Product and installation requirements for piping specialties, and equipment used in domestic water systems.
 - 6. Section 221313 - Facility Sanitary Sewerage Piping: Product and installation requirements for piping specialties, and equipment used in sanitary waste and vent systems.
 - 7. Section 221413 - Facility Storm Drainage Piping: Product and installation requirements for piping specialties, and equipment used in storm drainage systems.

1.02 REFERENCES

- A. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 67 - Butterfly Valves.
 - 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - 6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC – New Jersey Edition.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Related Section:
 - 1. Appendix 1.3 Geotechnical Report: Environmental conditions affecting products on site
- B. Do not install valves underground when bedding is wet or frozen.

1.10 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.01 GATE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Hammond Valve
 - 3. Milwaukee Valve Company
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings
- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, non-rising stem, hand-wheel, inside screw with back-seating stem, solid wedge disc, alloy seat rings, threaded ends.
- D. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel

operators for valves 6 inches (and larger mounted over 8 feet above floor.

2.02 BALL VALVES

A. Manufacturers:

1. Crane Valve, North America
2. Hammond Valve
3. Milwaukee Valve Company
4. NIBCO, Inc.
5. Stockham Valves & Fittings

B. Furnish materials in accordance with IBC – New Jersey Edition.

C. 2 inches and Smaller: MSS SP 110, 400 psi, one piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends, lever handle with balancing stops.

2.03 CHECK VALVES

A. Horizontal Swing Check Valves:

1. Manufacturers:

- a. Crane Valve, North America
- b. Hammond Valve
- c. Milwaukee Valve Company
- d. NIBCO, Inc.
- e. Stockham Valves & Fittings

2. Furnish materials in accordance with IBC – New Jersey Edition.

3. CK-1 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.

4. CK-2 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.

B. Spring Loaded Check Valves:

1. Manufacturers:

- a. Crane Valve, North America
- b. Hammond Valve
- c. Milwaukee Valve Company

- d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
- 2. Furnish materials in accordance with IBC – New Jersey Edition.
 - 3. CK-6 2 inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded] ends.
 - 4. CK-7 2-1/2 inches and Larger: MSS SP 71, Class 125, globe style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify piping system is ready for valve installation.

3.02 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 083113.
- F. Refer to Section 220529 for pipe hangers.
- G. Refer to Section 220700 for insulation requirements for valves.
- H. Install Work in accordance with IBC – New Jersey Edition.

3.03 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.
- B. Install ball or gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball valves for throttling, bypass, or manual flow control services.

- D. Install non-slam check valves on discharge of water pumps.
- E. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- F. Install ball or gate valves in domestic water systems for shut-off service.
- G. Install ball valves in domestic water systems for throttling service.
- H. Install drain valves at low points in domestic water system and at other locations to facilitate complete drainage of systems.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for hangers and supports for plumbing piping and equipment in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to plumbing work.
9. Firestopping accessories.
10. Equipment bases and supports.

- B. Related Sections:

1. Section 220503 - Pipes and Tubes for Plumbing Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
2. Section 221116 - Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
3. Section 221313 - Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
4. Section 078413 – Penetration Firestopping.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.5 - Refrigeration Piping.
 - 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 5. UL - Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- B. Product Data:
 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods sealed by a registered professional engineer.
- D. Manufacturer's Installation Instructions:
 1. Hangers and Supports: Submit special procedures and assembly of components.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- B. Perform Work in accordance with IBC – New Jersey Edition.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.08 WARRANTY

- A. Furnish five-year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.
- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. Plumbing Piping - Water:
 - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.02 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl compatible with roofing.
- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage at fire resistant elements.

2.05 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

2.06 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
 - 3. B-Line
- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.07 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems

3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.
- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.02 PREPARATION

- A. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- B. Do not drill or cut structural members.

3.03 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP58, MSS SP 69, MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper-plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.06 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower and mop sink drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.07 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install stainless steel escutcheons at finished surfaces.

3.08 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.09 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8

Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for identification for plumbing piping and equipment in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Samples: Submit two (2) tags and pipe markers, size used on project.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 EXTRA MATERIALS

- A. Furnish two (2) containers of spray-on adhesive.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
- B. Furnish materials in accordance with IBC – New Jersey Edition.

- C. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.02 TAGS

A. Metal Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.
 - b. Brady
 - c. Seton Identification Products
2. Brass with stamped letters; tag size minimum 2 inches diameter with finished edges.

B. Information Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.
 - b. Brady
 - c. Seton Identification Products
2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

- C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.03 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.

- b. Brady
 - c. Seton Identification Products
- 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.04 LABELS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Craftmark Identification Systems.
 - 2. Brady
 - 3. Seton Identification Products
 - 4. Description: Aluminum size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. All valves, and other concealed equipment shall be properly tagged with adhesive labels (size, color, font and nomenclature to be submitted and approved by Architect at the exact location where equipment is installed, either on ceiling grid or access door (as applicable).
- K. All exposed piping at ceiling requiring label shall be tagged with color: charcoal grey and identified appropriately.

END OF SECTION

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes requirements for plumbing insulation in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

1.02 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
18. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
19. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
20. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Samples: Submit two (2) samples of representative size illustrating each insulation type.

- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with IBC – New Jersey Edition.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.

2.02 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 1. Thermal Conductivity: 0.23 at 75 degrees F.
 2. Operating Temperature Range: 0 to 850 degrees F.
 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket. Conform to ASTM C795 for application on Austenitic stainless steel.
 1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Operating Temperature Range: 0 to 650 degrees F.
 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.03 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
 - 1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

2.04 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum, single-piece construction with self adhesive closure. Thickness to match pipe insulation.
- F. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- G. Adhesives: Compatible with insulation.

2.05 EQUIPMENT INSULATION

- A. TYPE P-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 1.5 pound per cubic foot.
- B. TYPE P-2: ASTM C612; glass fiber, rigid board, noncombustible with factory-applied, reinforced aluminum foil jacket.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 3.0pound per cubic foot.

4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- C. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
 1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Operating Temperature Range: 0 to 650 degrees F .
 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F .

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

F. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

G. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric,

with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

3.03 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
 - 1. Insulate entire equipment surfaces.
 - 2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 4. Finish insulation at supports, protrusions, and interruptions.
- E. Equipment Containing Fluids 140 degrees F or Less:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- F. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- G. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.04 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Domestic Hot Water Supply and Recirculation	P-1	1-1/4 inches and smaller	0.5
		1-1/2 inches and larger	1.0
Domestic Cold Water	P-1	1-1/4 inches and smaller	0.5
		1-1/2 inches and larger	1.0

END OF SECTION

SECTION 221116 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for facility water distribution in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Unions and flanges.
 - 2. Valves.
 - 3. Thermometers.
 - 4. Relief valves.
 - 5. Strainers.
 - 6. Hose bibs.
 - 7. Backflow preventers.
 - 8. Water hammer arrestors.
 - 9. Thermostatic mixing valves.
 - 10. Diaphragm-type compression tanks.
- B. Related Sections:
 - 1. Section 220503 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 220513 - Common Motor Requirements for Plumbing Equipment: Product requirements for motors for placement by this section.
 - 3. Section 220523 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
 - 4. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.

5. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
6. Section 220553 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
7. Section 220700 – Plumbing Piping Insulation: Product and execution requirements for pipe insulation.
8. Section 312300 – Excavation and Fill: Soils for backfill in trenches.
9. Section 312300 - Excavation and Fill: Aggregate for backfill in trenches.
10. Section 312300 - Excavation and Fill: Product and execution requirements for excavation and backfill required by this section.
11. Section 312300 - Excavation and Fill: Execution requirements for trenching required by this section.
12. Section 312300 - Excavation and Fill: Requirements for backfill to be placed by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.

B. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
4. ASME B31.9 - Building Services Piping.
5. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
6. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. American Society of Sanitary Engineering:

1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
6. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
7. ASSE 5015 - Performance Requirements for Testing Double Check Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (RPDF).

D. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
8. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

9. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
 4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 6. AWWA C651 - Disinfecting Water Mains.
 7. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
 8. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
 9. AWWA C702 - Cold-Water Meters - Compound Type.
 10. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
- G. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 67 - Butterfly Valves.
 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- H. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. Plumbing and Drainage Institute:
1. PDI WH201 - Water Hammer Arrester Standard.
- J. Underwriters Laboratories Inc.:
1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
 2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.03 SUBMITTALS

- A. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for valves and accessories.

- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and equipment.
- B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC – New Jersey Edition.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Related Sections:

1. Appendix 1.3 Geotechnical Report: Environmental conditions affecting products on site

- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve, two (2) loose keys for outside hose bibs, hose end vacuum breakers for hose bibs and two (2) pump seals for each pump model.

PART 2 - PRODUCTS

2.01 RELIEF VALVES

- A. Furnish materials in accordance with IBC – New Jersey Edition.
- B. Pressure Relief:
 1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- C. Temperature and Pressure Relief:
 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.02 STRAINERS

- A. Furnish materials in accordance with IBC – New Jersey Edition.
- B. 2 inch and Smaller: Threaded brass body for 175 psi.
- C. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.
- D. 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.03 HOSE BIBS

- A. Furnish materials in accordance with IBC – New Jersey Edition.

- B. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with lock shield and removable key, integral vacuum breaker in conformance with ASSE 1011.
- C. Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with hand wheels, and vacuum breaker in conformance with ASSE 1011.

2.04 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers:
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- B. Manufacturers:
 - 1. Ames
 - 2. Watts
 - 3. Conbraco
 - 4. Furnish materials in accordance with IBC – New Jersey Edition.

2.05 WATER HAMMER ARRESTORS

- A. ASSE 1010; stainless steel construction, bellows type sized in accordance with PDI WH-201.
- B. Pre-charged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.
- C. Manufacturers:
 - 1. J. R. Smith
 - 2. Wade
 - 3. Zurn

2.06 THERMOSTATIC MIXING VALVES

- A. Furnish materials in accordance with IBC – New Jersey Edition.
- B. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- C. Capacity: Per Contract Drawings.
- D. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.
- E. Cabinet: 16 gauge stainless steel, for surface mounting with keyed lock.

2.07 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Furnish materials in accordance with IBC – New Jersey Edition.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Size: per Contract Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.02 INSTALLATION - THERMOMETERS

- A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.03 INSTALLATION - ABOVE GROUND PIPING

- A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 220548.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 220700.
- H. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 083113.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Install domestic water piping in accordance with ASME B31.9.
- L. Sleeve pipes passing through partitions, walls and floors. Refer to Section 220529.
- M. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 078400.
- N. Install unions downstream of valves and at equipment or apparatus connections.

- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- R. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- S. Test backflow preventers in accordance with ASSE 5013 and 5015.
- T. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories.
- U. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures each washroom. Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

3.04 FIELD QUALITY CONTROL

- A. Test domestic water piping system in accordance with IBC – New Jersey Edition.

3.05 CLEANING

- A. Disinfect water distribution system and submit report.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali caustic soda or soda ash.
- D. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- E. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

- H. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for facility sanitary sewerage in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Floor drains.
 - 2. Cleanouts.
 - 3. Bedding and cover materials.
- B. Related Sections:
 - 1. Section 220503 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 220516 - Expansion Fittings and Loops for Plumbing Piping: Execution requirements for pipe expansion devices for placement by this section.
 - 3. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 4. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
 - 5. Section 220553 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
 - 6. Section 220700 – Plumbing Piping Insulation: Product and execution requirements for pipe insulation.
 - 7. Section 312300 - Excavation and Fill: Soils for backfill in trenches.
 - 8. Section 312300 - Excavation and Fill: Aggregate for backfill in trenches.
 - 9. Section 312300 - Excavation and Fill: Product and execution requirements for excavation and backfill required by this section.

10. Section 312300 - Excavation and Fill: Execution requirements for trenching required by this section.
11. Section 312300 - Excavation and Fill: Requirements for backfill to be placed by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.21.1 - Floor Drains.
2. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ASME B16.3 - Malleable Iron Threaded Fittings.
4. ASME B16.4 - Gray Iron Threaded Fittings.
5. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
6. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
7. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
6. ASTM A536 - Standard Specification for Ductile Iron Castings.
7. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
8. ASTM B32 - Standard Specification for Solder Metal.

9. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 10. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 11. ASTM B75 - Standard Specification for Seamless Copper Tube.
 12. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).
 13. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 14. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
 15. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 16. ASTM B251M - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric).
 17. ASTM B302 - Standard Specification for Threadless Copper Pipe.
 18. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- C. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

E. Plumbing and Drainage Institute:

1. PDI G101 - Standard - Testing and Rating Procedure for Grease Interceptors.

1.03 SUBMITTALS

A. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
3. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with IBC – New Jersey Edition.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with sewage ejector service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Related Sections:
 - 1. Appendix 1.3 Geotechnical Report: Environmental conditions affecting products on site
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 EXTRA MATERIALS

- A. Furnish two (2) sets of pump seals.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. J.R. Smith.
- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. Floor Drain (FD-1): ASME A112.21.1; 3" floor drains, J.R. Smith Fig No. 2005B, cast iron body, underdeck clamp, flashing collar, 8" square, adjustable strainer head, heel-proof grate with square holes, vandal proof, nickel bronze top.
- D. Floor Drain (FD-2, FD-3): ASME A112.21.1; Mechanical room 4" floor drains, J.R. Smith Fig. No. 3510-P050, cast iron body and cast iron grate, sediment bucket, flashing collar and funnel.

2.02 CLEANOUTS

- A. Furnish materials in accordance with IBC – New Jersey Edition.
- B. Exterior Surfaced Areas (CO-1): Round cast nickel bronze access frame and non-skid cover.
- C. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round epoxy coated cover with gasket.
- D. Interior Finished Floor Areas (CO-3): Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
- E. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.
- F. Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.03 BEDDING AND COVER MATERIALS

- A. Bedding: Fill as specified in Section 310516
- B. Cover: Fill as specified in Section 310516.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil, as specified in Section 310516. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 3 ft of cover.
- C. Establish minimum separation of 12 inches from piping in accordance with IBC – New Jersey Edition.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 312316.
- F. Install pipe to elevation as indicated on Drawings.
- G. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density].
- H. Install pipe on prepared bedding.
- I. Route pipe in straight line.
- J. Install trace wire continuous over top of pipe. Coordinate with Section 312300.
- K. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 312300.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.
- L. Install Work in accordance with IBC – New Jersey Edition.

3.04 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to $\frac{1}{4}$ inch per foot (1 percent) minimum; 2 percent for piping 2 inches and smaller. Maintain gradients.

- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain headroom. Do not spread piping, conserve space.
- H. Group piping whenever practical at common elevations.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 220700.
- K. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 083113.
- L. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- N. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- O. Install bell and spigot pipe with bell end upstream.
- P. Sleeve pipes passing through partitions, walls and floors.
- Q. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- R. Support cast iron drainage piping at every joint.
- S. Install Work in accordance with IBC – New Jersey Edition.

3.05 FIELD QUALITY CONTROL

- A. Test sanitary waste and vent piping system in accordance with IBC – New Jersey Edition.

END OF SECTION

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for commercial electric water heater in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
- B. Related Sections:
 - 1. Section: 221116 - Facility Water Distribution: Supply connections to domestic water heaters.

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings.
- B. American Society of Mechanical Engineers:
 - 1. ASME PTC 25 - Pressure Relief Devices.
 - 2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- B. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.
- C. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.05 QUALITY ASSURANCE

- A. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1.
- B. Perform Work in accordance with NYS standard.
- C. Maintain two copies of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept water heaters on site in original labeled cartons. Inspect for damage.
- B. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Furnish five year manufacturer warranty for water heaters.

PART 2 PRODUCTS

2.01 COMMERCIAL ELECTRIC WATER HEATERS

- A. Manufacturers:
 - 1. Bradford White.
 - 2. A. O. Smith.
 - 3. Patterson-Kelley Co.
- B. Furnish materials in accordance with NYS standard.
- C. Type: Factory-assembled and wired, electric, vertical storage.
- D. Capacity: As specified on drawings.
- E. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
- F. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F (16 to 82 degrees C), flanged or screw-in nichrome elements, high temperature limit thermostat.
- G. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.02 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Section 26 05 03.
- B. Disconnect Switch: Factory mount disconnect switch in Mechanical Room.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than water heater base on each side.

- C. Connect domestic cold water piping to supply and return water heater connections.
- D. Install the following piping accessories. Refer to Section 22 11 00.
 - 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.
 - d. Shutoff valve.
 - e. Air relief.
 - f. Expansion tube.
- E. Install discharge piping from relief valves and drain valves to nearest floor drain.
- F. Install water heater trim and accessories furnished loose for field mounting.
- G. Install electrical devices furnished loose for field mounting.
- H. Install control wiring between water heater control panel and field mounted control devices.
- I. Install Work in accordance with New Jersey State standard.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for plumbing fixtures in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Water closets.
2. Lavatories.
3. Mop Receptors
4. Drinking Fountain with Remote Control.
5. Sinks.
6. Trap primer

- B. Related Sections:

1. Section 079200 - Joint Sealants: Product requirements for calking between fixtures and building components for placement by this section.
2. Section 221116 - Facility Water Distribution: Supply connections to plumbing fixtures.
3. Section 221313 - Facility Sanitary Sewerage: Waste connections to plumbing fixtures.
4. Section 260519 - Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.02 REFERENCES

- A. American National Standards Institute:

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

- B. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

C. American Society of Mechanical Engineers:

1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
5. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
6. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
7. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.03 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Samples: Submit two (2) lavatory supply fittings and sets of color chips for each standard color.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC – New Jersey Edition.
- B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
- C. Maintain two copies of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.09 EXTRA MATERIALS

- A. Furnish two sets of faucet washers, flush valve service kits, lavatory supply fittings, shower heads and toilet seats.

PART 2 - PRODUCTS

2.01 FLUSH VALVE WATER CLOSETS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. Toto
 - 2. American Standard
 - 3. Kohler Co.
 - 4. J. R. Smith Company
 - 5. Wade
 - 6. Olsonite
 - 7. Sloan

- B. Furnish materials in accordance with IBC – New Jersey Edition.

2.02 LAVATORIES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. American Standard Plumbing.
 - 2. Toto
 - 3. Eljer Plumbingware.
 - 4. Kohler Co.
- B. Bowl: As specified on drawings.
- C. Faucet: As specified on drawings.
- D. Provide P-TRAP and keyed-stop valves with escutcheons.

2.03 MOP RECEPTORS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. Fiat
 - 2. Florestone
 - 3. Bradley Corp.
 - 4. Chicago Faucet Co.
 - 5. Kohler Co.
- B. Furnish materials in accordance with IBC – New Jersey Edition.

2.04 DRINKING FOUNTAINS WITH REMOTE CHILLER (P-4)

- A. Manufacturers:
 - 1. Elkay
 - 2. Bradley Corp.
 - 3. Briggs Industries, Inc.
 - 4. Halsey Taylor

- B. Furnish materials in accordance with IBC – New Jersey Edition.
- C. Electrical: refer to Electrical Drawing.

2.05 TRAP PRIMER

- A. PPP Inc. The Prime-Eze Trap primer # PR-500 Prime Rite as indicated on the plans.

2.06 LAVATORY INSULATION KIT

- A. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch (5 mm) thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify electric power is available and of correct characteristics.
- C. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install Work in accordance with IBC – New Jersey Edition.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome-plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 00, color to match fixture.

- G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

3.08 SCHEDULES

A. Fixture Mounting Heights:

1. Water Closet Flush Valves:
 - a. Standard: 11 inches min. above bowl rim.
 - b. Recessed: 10 inches min. above bowl rim.
2. Lavatory:
 - a. Standard: 31 inches to top of basin rim.
 - b. Accessible: 34 inches to top of basin rim.
3. Drinking Fountain:
 - a. Standard Adult: 40 inches to top of basin rim.
 - b. Accessible: 36 inches to top of spout.

B. Fixture Rough-In:

Fixture	Hot inches	Cold inches	Waste inches	Vent inches
Water Closet (Flush Valve):		1	4	2
Lavatory:	1/2	1/2	1-1/2	1-1/4
Sink:	1/2	1/2	1-1/2	1-1/4
Service Sink:	1/2	1/2	2	1-1/2
Mop Receptors:	1/2	1/2	3	1-1/2
Drinking Fountain:		1/2	1-1/4	1-1/4

END OF SECTION

SECTION 230500 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for all mechanical work including Heating, Ventilating and Air Conditioning Work, Fire Protection and Sprinkler Work in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Documents:
 - 1. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.
 - 2. This Section, 230500, governs all requirements as applicable to the mechanical work specified in other Sections of Division 23.
 - 3. The word "Mechanical" shall mean Plumbing, Drainage, Fire Protection, Heating, Ventilating, Air Conditioning and related work.
- C. Related Sections:
 - 1. Section 017300 "Execution" for Cutting and Patching.
 - 2. Section 013300 "Submittal Procedures."
 - 3. Section 013100 "Project Management and Coordination" for coordination drawings.
 - 4. Section 017839 "Project Record Documents."
- D. The term "HVAC" shall mean Heating, Ventilating and Air Conditioning.

1.02 DIVISION OF RESPONSIBILITY

- A. The requirements under Section 230500 are intended for the party or parties who have been duly awarded the applicable portion of work to be performed under the indexed sections of Division 23 also known as Heating, Ventilating and Air Conditioning Work, Fire Protection and Sprinkler Work.

1.03 REFERENCE STANDARDS

- A. Compliance with the following codes and standards shall be required as applicable:
 - 1. IBC International Building Code

2. IMC International Mechanical Code
3. USAS USA Standards Institute (Formerly ASA)
4. AMCA Air Movement and Control Association
5. ADC Air Diffusion Council
6. NEMA National Electrical Manufacturers Association
7. FM Factory Mutual
8. NFPA National Fire Protection Association
9. ASTM American Society for Testing Materials
10. UL Underwriters' Laboratories, Inc.
11. NEC National Electrical Code
12. ASME American Society of Mechanical Engineers
13. ANSI American National Standards Institute
14. OSHA Occupational Safety and Health Act
15. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
16. AWWA American Water Works Association
17. MSS Manufacturer's Standardization Society of the Valve and Fitting Industry
18. ARI American Refrigeration Institute
19. SMACNA Sheet Metal and Air Conditioning Contractor's National Association
20. TEMA Tubular Exchanger Manufacturers Association
21. AGA American Gas Association
22. NACE National Association of Corrosion Engineers
23. ASSE American Society of Sanitary Engineering
24. DOE United States Department of Energy
25. EPA United States Environmental Protection Agency
26. IFC International Fire Code

- B. Conform to materials and equipment rating standards, listings or classifications of the above organizations as well as ratings, listings or classifications accepted under local codes and laws.

1.04 ABBREVIATIONS

- A. In addition to those listed below, meanings of common abbreviations used in text of Division 23 of the Project Specifications are tabulated in ASHRAE Handbook, "Fundamentals", latest edition.

- B. Project Abbreviations:

MER	Mechanical Equipment Room
HVAC	Heating, Ventilating and Air Conditioning
ATC	Automatic Temperature Control
BMS	Building Management System
CM (GC)	Construction Manager (General Contractor)
AC	Air Conditioning
H & V	Heating and Ventilating
AWG	American Wire Gauge
BWG	Birmingham Wire Gauge
USS	United States Standard
B & S	Brown & Sharpe
OS & Y	Outside Screw and Yoke
IBBM	Iron Body Brass Mounted
WSP	Working Steam Pressure
PSIG	Pounds per Square Inch Gauge
PRV	Pressure Reducing Valve
GPM	Gallons per Minute
MBH	Thousand BTU per hour
BTU	British Thermal Units
F	Degrees Fahrenheit
WG	Water Gage
GPM	Gallons Per Minute
#	Number
SP	Static Pressure
CFM	Cubic Feet per Minute
LB	Pound (Also shown as: #)
	See Drawings for additional abbreviations

1.05 DEFINITIONS

- A. "Provide" means furnish and install, complete, the specified material, equipment or other item and perform all required labor to make a finished installation.
- B. "Furnish and install" has the same meaning as given above for "Provide."

- C. "Architect" means the authorized representative of the Owner.
- D. Refer to General Conditions for other definitions.

1.06 MEASUREMENTS

- A. Contractor shall base all his measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. He shall verify all measurements at site; and check the correctness of same as related to the work.

1.07 LABOR AND MATERIALS

- A. All materials and apparatus required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces.
- B. Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the Owner.

1.08 COVERING OF WORK

- A. No pipe, fitting, or other work of any kind shall be covered up or hidden from view before it has been examined or approved by the Engineer, Architect, and/or other authority having jurisdiction over same. Any unacceptable work, or unauthorized or disapproved materials discovered shall be removed and corrected immediately after being condemned.
- B. Any type of equipment shown or specified to be installed outdoors, on grade or on roof, shall have appropriate protection against outdoor weather. Equipment such as motors, panels, etc. shall have rain hood or appropriate protection as provided under Division 23. Insulated pipes shall have aluminum covers or as specified. Insulated ducts shall be provided with aluminum jacket with overlapping, sealed joints. Uninsulated ducts shall be soldered joints and seams or as specified. Where no protection is feasible, such as in exposed vibration springs, hangers, pipe or steel members, such items shall be hot dipped galvanized or as approved by the Architect.

1.09 PROTECTION

- A. Contractor shall protect the work and material of all trades from damage by his work or workmen, and shall replace all damaged material with new.

- B. Contractor shall be responsible for work and equipment until his work is finally inspected, tested, and accepted; he shall protect his work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.
- C. Contractor shall be responsible for the preservation of all public and private property, along and adjacent to the work, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and shall carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove them until directed.
- D. All mechanical and electrical equipment delivered to the site shall have appropriate wrapping to protect them from rain, flood, wind, construction debris and all types of water damage normally encountered at the construction sites. Protection of equipment such as fans, coils, valves and similar equipment shall be the responsibility of the Contractor receiving such equipment at the jobsite for installation under Division 23 Contract.

1.10 CONCRETE AND GROUTING

- A. Requirements for concrete and grouting are specified in other Sections.
 - 1. Concrete shall be 3,000 psi stone concrete with water reducing admixture, except where otherwise specified.
 - 2. Concrete shall have air entraining admixture where exposed to weather.
- B. Contractor shall make coordinated layouts showing concrete work required for housekeeping pads, roof curbs, thrust blocks, etc. which are cast in place.
- C. Concrete housekeeping pads: 4" minimum thickness, sized to cover the full area of each piece of equipment provided under Concrete Work.
- D. Concrete bases: Dimension and height to suit the equipment.
- E. Concrete inertia blocks for vibration isolation. Dimensions designed by the vibration isolation equipment manufacturer and inertia block provided by Division 23, under Mechanical work.
- F. Outside the building all concrete work related to mechanical equipment shall be provided by the Trade Contractor of Division 23, unless otherwise noted in the Contract Documents.

1.11 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

- A. Noise levels from operation of motor driven equipment, whether airborne or structure-borne, and noise levels created by or within air handling equipment and air distribution and control media, are not to exceed sound pressure levels determined by the noise criteria curves in the ASHRAE Guide and as noted under Section 23 05 48.
- B. Acoustical Tests:
 - 1. Architect may conduct sound tests for those areas or equipment he deems too noisy.
 - 2. If NC level in any space exceeds that in the schedule or the specification due to improper installation or operation of mechanical systems, the Contractor is required to make remedial changes or repairs.
 - 3. Contractor is required to retest until specified criteria has been met.
- C. All equipment shall meet IBC requirements for airborne noise.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Instructions and Demonstration for Facilities Personnel:
 - 1. After all equipment is functioning properly, each system is to be automatically operated for ten (10) working shifts, and not to be adjusted during this period, 80 hours in heating and 80 hours in cooling seasons, scheduled at the convenience of the Facilities Personnel. Any adjustments shall void the test and start the time period all over again.
 - 2. The hours of operation are to include the Facility's designated personnel in each shift, for each season.
 - 3. During this period, instruct the Facilities personnel in the use, operation and maintenance of all equipment of each system. Teaching shall include a lecture-type instruction given in a non-machine room environment. During the lesson, normal operation of the system installed and operating shall be explained, along with troubleshooting procedures. This shall be followed by a field inspection and demonstration of equipment.
 - 4. The above instruction is exclusive of that required of specified equipment manufacturers. If more stringent or longer instruction is indicated for specific equipment or systems, these shall supersede the above requirements.

B. Operating and Maintenance Data:

1. Provide complete sets of manufacturer's catalogues, instructions, maintenance and repair information and parts lists for operating equipment and devices.
 - a. Include performance curves for fans and pumps, factory furnished wiring diagrams and control diagrams, and applicable flow diagrams.
 - b. Submit seven sets of instructions for distribution.
2. Data for the equipment actually installed is to be submitted.
3. The data is to be carefully checked for accuracy by comparison with the installed equipment nameplates.
4. Provide a recommended list of spare parts for equipment and list of special, non-standard tools to service equipment.
5. Index and assemble the instructions in durable loose-leaf binders.
6. The completed binders are to be available at the time the equipment installation begins.

1.13 WARRANTY

- A. The following supplements the GENERAL CONDITIONS for Mechanical Work:
1. Non-durable, expendable items such as replaceable (not cleanable) air filter media are not subject to replacement after the date of acceptance.
 2. Warranty time limits for equipment exceeding those indicated in GENERAL CONDITIONS are specified in the applicable Sections of Division 23.

1.14 FIRE PROTECTION PIPING TEST

- A. For testing of plumbing and fire protection piping, comply with Codes, Laws, and any other requirements listed in the applicable Sections of Division 23. Sprinkler system and standpipe require 2 hours of testing.
- B. Provide reports for all tests; file reports with appropriate authorities required by Codes and Laws.

PART 2 - PRODUCTS

2.01 IDENTIFICATION MARKINGS

- A. Every valve, damper, control, and apparatus installed under this Contract shall be tagged, labeled or stenciled as follows: Tags and labels securely fastened by brass chains, screws or mastic as applicable. Equipment controls numbered according to equipment schedules on Plans. Tags numbered to conform to a directory listing number, location and use. Directories to be mounted under glass in aluminum self-closing frames as made by Seton Name Plate Co. of New Haven, Connecticut, 8-1/2" x 11" in size.
1. Apply identification after testing, insulation and field painting are completed.
- B. Valve Identification:
1. Provide an identification tag for each valve, including control valves.
 2. Differentiate between the different classes of service in the numbering systems.
 3. Use 2" brass tags stamped with designation numbers 1" high, filled in with black enamel.
 4. Attach tags securely to handles or spindles of valves with heavy brass "S" hooks or brass chains.
 5. Provide six copies of valve charts with one of each framed under glass and mounted where directed.
- C. Piping Identification:
1. Provide on bare and covered pipes for all services.
 2. Use a system of marking and colors conforming to ANSI A-13.1, as supplied by Seton Name Plate Corp., or W.H. Brady Co.
 3. Install to provide permanent adhesion.
 4. Install in readily visible location.
 5. Apply legend and flow markers as required for maintenance purposes, with at least one marker in every 50'-0" of each line and at every change of direction.
 6. Color Coding of Piping: After piping has been finish painted, the installer of the piping shall identify the type of service lines with

applied color bands and stenciled letters. The direction of flow shall be indicated with stenciled arrows. Color bands shall be 1-inch wide, finished in gloss enamel; lettering and arrows shall be same color as the bands. Specify that indicators be applied at connections to pumps and other equipment; at entrances to spaces; adjacent to valves; near access doors to pipe spaces; and at maximum intervals of 50 feet on long pipe runs. Specify that letters be positioned to be easily read from a normal standing position.

D. The following colors and letter designations shall be used:

HVAC PIPING

<u>Service</u>	<u>Color</u>	<u>Designation</u>
Pumped Condensate	Yellow	PR
Hot Water Supply		HWS
Hot Water Return	Brown with Orange Band	HWR

FIRE PROTECTION PIPING

<u>Service</u>	<u>Color</u>	<u>Designation</u>
Sprinkler	Red	Sprinkler
Standpipe	Red	Standpipe

E. Equipment Identification:

1. Provide stencil lettering on operating equipment and units:
 - a. Use black oil base paint, except where equipment finish is dark, use white paint.
 - b. Make all characters distinguishable from the floor, but not less than 2" high.
2. For each motor starter, controller and similar accessory provide a lamicore nameplate attached with screws or rivets to a fixed part of the equipment in a visible location.
 - a. Make plates not less than 2" x 1" x 1/8" thick with 1/4" high characters.
3. Equipment such as fans, tanks, ducts, access doors to equipment such as filters, coils, fans, neatly stenciled with letters not less than 1 inch high. Any equipment too small to receive such stenciling shall be provided with brass name tags 2" x 1" in size.
 - a. Label ducts by function (supply air, return air, exhaust air and transfer).

4. In areas where removable ceilings occur, install appropriate color coded tile markers to indicate location of valves and other equipment or fittings that may require maintenance service.

F. Refer to Section 230553 for additional requirements.

2.02 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Keep piping 2'-0" outside the vertical line of unprotected electrical equipment or provide non-corrosive metal (soldered 20 gauge copper or welded stainless steel), watertight support, pans piped to an open drain.
 1. Construct and support pans to hold minimum depth of 3 inches of water.

2.03 ACCESS DOORS

- A. General:
 1. Steel, flush four-sided frame and door assembly, chemically cleaned after fabrication and painted with rust inhibitive primer.
 2. Provide hardware and locking devices.
 3. Provide access doors required for access to mechanical work through finished wall construction and non-removable ceiling construction.
 4. Deliver doors and location information to appropriate trade for installation.
- B. Furnish for installation by the appropriate trade, flush type access door or panel no smaller than 18" x 18" and no larger than 30" x 30" for all dampers, valves, cleanouts, or apparatus located in chases, walls, non-accessible hung ceilings or floors; finish shall be prime coat, except floor panels which shall be polished brass or chrome plate. Doors and trim 14 gauge steel, frame 16 gauge steel, with flush concealed and standard flush locks, screwdriver operated cams, of Milcor manufacturer or approved equal.
 1. All panels and their exact location subject to approval of the Architect.
 2. Where space conditions prevent door swinging open, provide removable door on lift-up hinges. This shall only be accepted on a case-by-case basis. This condition must be submitted to the Facilities Department and Architect for approval prior to installation.

3. Furnish a complete list locating all access doors required in finished walls, ceilings, partitions, shafts and other inaccessible locations.

2.04 PAINTING

- A. All piping, supports, auxiliary steel and miscellaneous iron within all MER's shall be prime painted as specified herein.
- B. All exposed uninsulated piping, fittings, equipment stands, supports, platforms, cradles, and hangers; except chrome finished materials, shall be painted. All ungalvanized surfaces shall be painted with zinc chromate, or approved equal, and all galvanized surfaces shall be prime coated with a phosphate pretreatment coating, dry film thickness of 0.35 with a 0.50 mil. one coat Glid-Guard galvanized steel primer Y5229, or approved equal.
- C. Upon completion of the prime coat of all mechanical equipment specified above, all insulated and exposed piping shall be painted with finish coating, Paint and/or other Sections. This Section shall complete stenciling and color identification, specified under Division 23, following the finish painting.
- D. Except where otherwise specified, steel piping in concrete and buried steel piping and steel tanks:
 1. Provide heavy coat of bituminous solution primer.
 2. In accordance with NFPA and other applicable codes.
- E. Provide custom factory finishes, except as noted, to match Architect's color samples, for items appearing in exposed finished work, and including:
 1. Equipment
 2. Registers and grilles
 3. Diffusers
 4. Enclosures on equipment
 5. Thermostat Covers
- F. All damaged factory painted surfaces shall be repaired to match original surface. If, in opinion of Facilities Department, such repairs are unsatisfactory, item in question shall be completely refinished or replaced with new.

2.05 WELDING

A. General:

1. All welding procedures, welders, and welding operators shall be qualified in accordance with the requirements of ASME/ANSI B31.9 and Section IX of the ASME Code, latest editions.
2. Welding procedures shall be reported on ASME Section IX Forms "QW," or its equivalent. Joint preparation sketches (to be included with the welding procedures) shall show all dimensions including tolerances, for bevel angle, land size, offset and root gap.
3. Contractor shall be responsible for the welding performed by personnel of his organization and shall conduct the required qualification tests and submit results to the Facilities Department for their review and approval.
4. All welding procedures shall meet requirements of local code and certification requirements. The filling of MSDS form shall be held in the field office.
5. A copy of the welders and fire watch certificate shall be held in the field office of the sight.

B. Processes:

1. Employ the Manual Shielded Metal-Arc (SMAW) welding process.
2. Double butt welding shall be permitted on all joints accessible from both sides. Where double butt-welding is employed, the first root pass shall be back-chipped.
3. Welding of pressure parts shall be performed with low hydrogen type electrodes. Electrodes of Classifications E6012, E6013, E7014 and E7024 shall not be used.
4. Brazing and Soldering:
 - a. The Contractor shall prepare applicable "Brazing and Soldering Procedures" forms for approval of the Architect.
 - b. Brazing shall conform to ASME Section IX.
 - c. Soldering shall conform to the relevant procedures in the manuals of the Copper Development Association.
 - d. For all refrigeration piping, the mechanics shall be skilled and specially trained in this type of pipe joining.

- e. The Architect may reject any brazed or soldered joint for lack of penetration or for other applicable grounds. These defective joints shall be redone until satisfactory.
- C. Quality of Workmanship - In addition to conformance with the procedural and quality requirements set forth in the applicable Code or material specification, all welding shall meet the following requirements.
- 1. Butt welds shall have full penetrations and shall be slightly convex with uniform height.
 - 2. Each weld shall be uniform in width and size throughout its full length.
 - 3. Each layer of welding shall be smooth, free of slag, cracks, pinholes, undercut in excess of 1/32" and completely fused to adjacent weld beads and base metal.
 - 4. Cover passes shall be free of coarse ripples, irregular surface, non-uniform bead patterns, high crown, and deep ridges or valleys between heads. The surface smoothness of the finished weld shall be suitable for the proper interpretation of non-destructive examination of the weld.
 - 5. Surfaces of parts to be joined by welding shall be cleaned of all oil, grease, paint, scale and rust with solvent and/or wire brushing.
 - 6. Fillet weld size shall be in accordance with the applicable code or as specified on the drawings with full throat and legs of equal length.
 - 7. Welding filler metal and welding flux shall be properly stored in such a manner as to insure that no damage to the coating or corrosion of weld rod shall occur. Low hydrogen type electrodes shall be stored in enclosures which provide a regulated temperature as prescribed by the electrode manufacturer. All electrodes shall be properly identified.
 - 8. Socket welds shall have a gap of approximately 1/16" between the bottom of the socket and the end of the pipe prior to welding. Socket welds shall have a minimum of two weld layers.
- D. Repair and Weld Defects:
- 1. A weld is defective and shall be repaired if it does not meet the acceptance standard of each applicable non-destructive examination as defined ASME/ANSI B31.9, latest edition.
 - 2. Repairs shall be made in accordance with ASME/ANSI B31.9, latest edition.

- E. Welding Identification and Weld Marking:
1. All welds must be identified with the welder's identifying symbol. Welds, where more than one welder performs the work, shall be stamped by each welder.
 2. Marking shall be done by a permanent method that shall not result in sharp discontinuities.
 3. Where stamping or marking on the base materials is not practical or feasible, permanently affixed metal bands of the same material may be applied. Stamping or any method of permanent marking on the bands is acceptable.

2.06 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled, and as specified.
- B. Equipment of other manufacturers shall be considered, subject to its acceptability and the following:
1. The equipment must conform to the structural design provisions for loads applied to the structure; to the dimensions established by drawings for spaces and other (service, etc.) clearances; and for inlet and outlet locations and relationships to associated equipment, piping and ducts.
 2. Changes to the building arrangement or structure, which are required to suit equipment offered must be by the Contractor at no extra expense to the Owner.
 3. Changes to the electrical requirements such as circuit breaker or starter size, conduit or wire size shall be coordinated by the Contractor and the expense borne by him with no additional cost to the Owner.
- C. Operating equipment, operating systems and other products are specified by names and models and also by performance criteria standards:
1. Where both specifying media are employed, the names and models establish a standard for manufacturing quality, while the performance criteria governs the capacity, rating or output.
 2. In any question regarding intent, the capacity, rating or output which is compatible with the other systems, is intended to be of prime concern and is to be provided.
- D. The descriptions of equipment and systems cover basic equipment and operation, but not all the details of design and construction.

1. The use of singular in descriptions does not limit the quantities to be furnished to produce the complete system, together with the results specified.
 2. Furnish equipment required to provide specified performance under installed conditions.
 3. Factory wiring and piping is to conform to specifications for field work, unless otherwise specified.
 4. Provide trim, enclosures and accessories required to make complete installation in each instance.
- E. All Mechanical Drawings of Division 23 are schematic and diagrammatic.
1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but they do not necessarily have dimensional significance, neither do they necessarily include all related and subsidiary parts and equipment.
 2. The work is to be installed complete and ready for operation in conformity with the intent expressed on the Drawings and in the Specifications.
 3. Coordinate work with the requirements of the Architectural and Structural drawings for dimensions, locations and clearances.
 4. Locations of mechanical and electrical items which are exposed to view shall be taken from the Architectural Drawings where available, or are to be located as directed by the Architect.
 5. Provide all transitions in piping and ductwork transition pieces, etc. as required for a complete and operational system.

2.07 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for equipment requiring them.
1. Level and shim the equipment; coordinate and oversee the grouting work.
 2. After one week of continuous operation, the technician shall return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.
- B. Field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspection, adjustments and approval by the manufacturer, as a part of the Contract.

C. Alignment and Lubrication Certification for Motor Driven Apparatus:

1. After permanent installation has been made and connections have been completed, but before the equipment is continuously operated, a qualified representative of the manufacturer is to inspect the installation and shall report in writing on the manufacturer's letterhead as follows:
 - a. That shafts, bearings, seals, couplings, and belt drives are perfectly aligned and doweled so the equipment shall remain perfectly aligned in the normal service intended by the Documents and that no strain or distortion shall occur in normal service. All dowels shall be aligned after equipment is running.
 - b. That all parts of the apparatus are properly lubricated for operation.
 - c. That the installation is in accordance with manufacturer's instructions.
 - d. That suitable maintenance and operating instructions have been provided for the Owner's use.

D. Belt Drives:

1. V-belt drives shall include a driving and driven sheave grooved for belts of trapezoidal cross-section. Belts shall be constructed of fabric and rubber so designed as not to touch the bottom of the grooves, the power being transmitted by the contact between the belts and V-shape groove sides. Drives shall be designed for a minimum of 150 percent of motor horsepower. Drive sheaves shall be of the companion type.
2. All motors shall be provided with fixed sheaves, once the correct speed is determined during testing/balancing period.
3. All fans shall be installed with fixed pitch sheaves on their drive motors. Sheaves shall be selected to provide air quantities under specified conditions. Air systems shall be put into operation, and Contractor shall determine actual size of sheaves required to produce specified air quantities on installed systems via the use of adjustable sheaves. Adjustable pitch sheaves shall then be replaced with the proper size fixed sheave. Adjustable pitch sheaves shall be property of Contractor and removed from premises.

E. Machinery Guards:

1. Motor drives shall be protected by belt guards furnished by the equipment manufacturer or in accordance with the Sheet Metal and Air Conditioning Contractors National Association's Duct Manual. In all cases, guards of all types must be as approved as acceptable under OSHA Standards.

F. Equipment Startup:

1. Each equipment manufacturer is to provide qualified personnel to inspect and approve equipment and installation and to supervise the startup of the equipment and to supervise the operating tests of the equipment.
2. If a minimum number of hours for startup and instruction are not stated with the equipment specifications, these shall be 2 full 8-hour working days as a minimum.
3. Advise Facilities Department of startup at least 72 hours in advance.

2.08 CLEANING AND ADJUSTING

A. Notification:

1. Inform Facilities Department and architect's field representatives of all cleaning, blowing out and fill-up schedules one week prior to starting.
2. Notify Facilities Department and architect again, 48-hours prior to each event. If neither attends the procedures, notify in writing, the specific task performed 24-hours after each event.
3. Leaks appearing during the various pressure tests shall be corrected by replacing all defective materials or welds and subsequent tests shall not be made until the piping is found in perfect condition. Caulking of screwed joints or peening of welds is prohibited. Wherever it is necessary to cut out a weld and the ends of the pipe cannot be conveniently brought together, then a short piece shall be fitted in and welded.
4. Damage to the building and equipment resulting from tests shall be repaired at no additional cost to the Owner.
5. Tests claimed to have been performed without following above procedures shall be deemed as not performed.

B. Cleaning:

1. Blow out, clean and flush each piping system and equipment, to clean thoroughly. MSDS forms for clean agent and procedure shall be presented to the field office. After cleaning, the systems shall be tested by an independent organization, approved by Architect prior to testing.
2. Clean all materials and equipment; leave in condition ready to operate and ready to receive succeeding finishes where required.
3. Clean the operating equipment and systems to be dust free inside and out.
4. Clean concealed and unoccupied areas such as plenums, pipe and duct spaces and equipment rooms to be free of rubbish and dust.
5. After completion of all pressure tests, properly clean every piece of apparatus furnished and remove caps and other provisions made for testing purposes only.
6. Cutting oil, excess pipe joint compound, finely divided solids and other similar foreign material shall be removed from all circulating water systems before they go into operation. Before chemical cleaning of water systems flush with clean water. Each system shall be cleaned chemically with circulating solution using cationic polymer similar to "Drewspense 729" or approved equal. Fill, vent and circulate the system with this solution at maximum operating temperature for at least one 8 hour period. During cleaning procedure, circulation shall be stopped periodically followed by blow off at all low points. Immediately following chemical cleaning, system to be drained and then refilled with clean water to which treatment shall then be added. After systems have been drained, flushed and refilled, a chemical test shall be made to determine that the cleaning solution remaining in the system does not impart alkalinity to the water in excess of 300 ppm.
7. After the water piping system has been properly cleaned as indicated above, each water system shall be operated for a minimum of 3 days with 1/2" surgical felt, bonded to baskets on each pump strainer. Felt filters shall be run for as long a time as necessary to thoroughly clean all piping until approved by Owner's representative. During the cleaning period, heat exchangers and coil valves shall be kept closed for the entire cleaning period. Provide one (1) inch manual bypass at equipment to permit flushing of branch piping. For flushing and blow-off for main risers, provide drain valves at the bottom in the horizontal runout to the riser. Also provide an additional valve in

the cyclo-clean separator piping for pumps with mechanical seals so that separator discharge water may be wasted during the cleaning procedure.

8. All pipe strainers shall be removed and cleaned upon completion of blowdown period.
9. After this period of operation, all systems shall be drained and refilled with fresh water and new chemicals as specified.
10. All equipment installed shall be thoroughly cleaned in preparation of the finished painting.
11. All dowels shall be aligned after system is running.

C. Adjusting:

1. Adjust and align equipment interconnected with couplings or belts. After one week of continuous operation, the technician shall return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.
2. Adjust valves of all types and calibrate equipment of all types to provide proper operation.
3. Clean all strainers after system cleaning and flushing and again before final system startup.
4. Motors, fans, pumps, compressors, etc. shall be properly oiled and left ready for operation.
5. Verify that each and every supply and return and exhaust fan, each fan coil unit fan, motor and automatic control valve is in running condition. All equipment shall be cleaned, including coils, motors, housing, pans, etc. and inspected by Facilities Department.
6. Submission of certified tests shall, in no way, relieve the Contractor of fulfillment of guarantee.
7. Gauges, instruments, thermometers and meters shall be checked and tested to specified accuracy.
8. Alarms shall be tested to fulfill satisfactory operating conditions.
9. Allow sufficient time to perform all tests, adjustments, etc., necessary to place the various systems in final operating condition, verify performance requirements and check all safety devices. Labor, instruments, etc., required for various tests shall be furnished by Contractor. The Contractor shall see that all his Sub-

Contractors, manufacturer's representatives or Field Engineers necessary to check and adjust various systems are present, with sufficient forms, and that all test results are recorded properly and turned over to the Owner for approval.

10. The Owner's representative shall make final check for all systems only after Contractor has completed and returned to the Owner all recorded test data together with letter that his work is 100% complete. Additional tests may be required to meet the requirements of Facilities Department's documents for demonstration of various systems, whether or not specified, to verify performance, workmanship or for adjustments.
11. Unless otherwise specified, equipment shall be installed and adjusted in accordance with manufacturer's recommendations to function properly with capacities required or specified.

D. Running Test of Piping Systems:

1. Any section of the work, after it has been completed and otherwise satisfactorily tested, shall be put in actual operation by Contractor and operated by him for a period of 2 days of 24 hours each, during which time any defects which may appear shall be remedied and any necessary adjustments shall be made. Test shall be performed in the presence of the Owner or representative, and serve as part of the Instructions Program.
2. During the time of the tests, repack all valves, make all adjustments and otherwise put the apparatus in perfect condition for operation, and shall instruct the Owner's authorized personnel in the use of management of the apparatus. All joints shall be made absolutely tight under tests. Caulking of pipe joints or makeshift methods of repairing leaks shall not be allowed. Piping which is not tight under tests shall be taken down and reassembled.
3. All gauges, thermometers, alarms, instruments, etc. shall be tested to demonstrate that they are functioning properly and within the range of these devices, and to show their degree of accuracy.
4. If during the first test run, the system cannot be completely vented within 24 hours, install additional air vents at high points of system to facilitate quick venting of all water systems.

E. Permanent Equipment Operating During Construction:

1. Use only in same service as the permanent applications, provided that written approval is granted by Architect.
2. Use disposable filters during temporary operation.

3. Expendable media, including belts used for temporary operation and similar materials are to be replaced just prior to acceptance.
 4. Packings in equipment operated during construction must be repacked just prior to system acceptance, using materials and methods specified by the supplying manufacturer.
- F. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.
- G. Tools:
1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.
- H. Fan and Pump Characteristic Charts:
1. Fan Characteristic Charts: Furnish 4 characteristics curve charts for each fan, including those embodied in factory assembled units. Characteristic curve charts shall not be less than 8-1/2" x 11" and shall show the static pressure, capacity, horsepower and overall efficiency for operating conditions from no load to 130% specified load.
 2. Pump Characteristic Charts: Furnish 4 characteristic charts for each pump. Charts shall be not less than 8-1/2" x 11" showing head developed, efficiency and power required for varying capacities at the operating speed of the equipment.

PART 3 – EXECUTION

3.01 GENERAL

- A. Temporary Protection:
1. Provide and maintain protection for the work whether completed or in progress.
 2. Provide suitable coverings and enclosures.
- B. Scaffolding, Rigging and Hoisting:
1. Provide all scaffolding, rigging and hoisting services necessary for erection, and/or delivery into the premises, of any equipment and apparatus furnished. Remove from the premises when no longer required.
- C. Waterproofing:
1. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the

Architect before work is done. This Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

3.02 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

- A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus requiring access for service and maintenance.
- B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding shall be permitted only when approved by the Architect.
- C. Submit shop drawings of supports for approval to the Architect before fabricating or constructing.
- D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.
- E. Where supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

3.03 ACCESSIBILITY

- A. The installation of valves, dampers and other items shall be conveniently and accessibly located with reference to the finished building floors, walls, roof and penthouses as applicable.
- B. In-line pumps shall not be installed higher than 7 ft. above floor and shall be fully accessible for servicing its motor, valves, controls and instruments.
- C. Equipment removal, tube-pull access door swing spaces shall be identified on shop drawings and maintained during installation.

3.04 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof, for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Use of permanent equipment for temporary services must be approved in writing by Owner.

3.05 CODES, RULES, PERMITS & FEES

- A. The Contractor shall give all necessary notices, obtain all permits and filings including, but not limited to, International Building Code requirements, and pay all government sales taxes, fees, and other costs, in connection with his work. However, all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity shall be paid directly to utility companies unless otherwise indicated. The Contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Owner's representative before request for acceptance and final payment for the work.
- B. The complete design and construction shall conform to the requirements of the IBC, NFPA, NEC, FM, UL and any other local or state code which may govern.
- C. Provide all New Jersey State permits for equipment, systems, etc. as required.

3.06 CODE COMPLIANCE

- A. As part of this Mechanical work, each Contractor is required to provide services of an independent agency for purposes of enforcing code compliance, including controlled inspections, as follows:
- B. For the entire duration of this construction, obtain the services of an independent organization headed by a New Jersey State licensed professional engineer for purposes of monitoring compliance with all applicable codes in general and providing controlled inspection on all items as required by the IBC, including but not limited to:
 - 1. Construction of ducts and its accessories including hanger installation.
 - 2. Air intakes and outlets.
 - 3. Electrical wiring and equipment pertaining to mechanical equipment.
 - 4. Air cooling and heating equipment.
 - 5. Fire and smoke dampers.
 - 6. Controls.
 - 7. Heating and combustion equipment.
 - 8. Special Structural Concrete poured under this Contract.

9. Fire stopping at penetrations.
- C. The independent organization shall have no affiliation with contractor and shall be responsible for compiling; issuing and submitting to the Construction Manager and/or Architect all code required reports and forms.
- D. Within his bid, the contractor shall submit for approval the name of the organization under whose direct supervision the monitoring of code items as specified shall be made. The submission shall also include the methods and forms proposed to be used to perform his work.
- E. Regular Inspection Services: Provide a part-time field inspection supervisor qualified to monitor the project for code compliance and having five to ten years previous field experience in supervising similar Mechanical system installations.
- F. Controlled inspection procedures shall, in general, insure the following:
 1. The adherence of the standards of material and workmanship required by the International Building Code.
 2. The checking of building processes and the evaluation of materials to insure conformity with the International Building Code.
 3. The elimination of unspecified, non-conforming substitutions.
 4. The discovery of discrepancies between the International Building Code requirements and the final Drawings or Specifications and their early correction.
 5. The prevention of error which may result in unnecessary and costly maintenance or upkeep costs.
 6. The determination of necessary tests and laboratory work.
- G. Also furnish to the Owner's Construction Manager and/or Architect weekly progress reports. These reports shall state the following:
 1. The progress of inspections and filing for the previous week.
 2. Although discrepancies shall be reported to the Construction Manager and/or Architect immediately upon discovery, they shall be included in the reports, as shall the resolution of these discrepancies.
 3. Tests witnessed during the week and code items whose installation has been completed during the same period.

3.07 FINAL INSPECTION

- A. Contractor shall arrange and schedule final inspection of work and shall notify the Architect in writing that the Contractor has thoroughly checked his work and, in the opinion of the Contractor, is ready for final inspection.
- B. During the entire period schedule for these inspections, the Contractor and representatives of each manufacturer of equipment involved shall be present. All of these organizations shall have sufficient and competent personnel present so that adjustments can be made to all systems without delay.

3.08 ACCEPTANCE

- A. The operation or the temporary use of the equipment and the mechanical and electrical installation, by the Owner does not constitute an acceptance of the work. The final acceptance is to be made after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the Contract Documents, and has furnished all the required Certificates. Warranties and guaranties are effective after the acceptance.

END OF SECTION

SECTION 230501 - SCOPE OF HVAC WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes general scope of work for HVAC and Fire Protection in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. This list is not intended to be all inclusive; follow all applicable specifications and furnishing for full scope of work.
- B. Related Sections:
 - 1. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.
 - 2. Requirements of Section 230500 shall also govern work specified herein, together with all applicable paragraphs of Mechanical sections.

PART 2 - SCOPE OF WORK

2.01 WORK INCLUDED

- A. This Specification and the accompanying Contract Drawings are intended to include the furnishing and installation, in a workman-like and approved manner, of all labor, materials, equipment and appliances necessary and required to completely install the HVAC and Fire Protection Systems as specified and shown on the Drawings.
- B. General scope of work shall be as listed below, however, omission of specific items shall not be construed as being omitted from the Contract if the item is mentioned elsewhere or implied.
- C. The list is not intended to be complete, but it is to serve as a guide to the character and extent of the work, and in general, shall consist of the following:
 - 1. Fire protection water service connection.
 - 2. Water meters in conjunction with above paragraphs.
 - 3. A complete sprinkler protection system as specified.
 - 4. Cleaning of all piping and duct systems prior to operation.
 - 5. All electrical interlock wiring, except as noted otherwise.

6. Complete DDC control with expansion of and tie-in to existing BAS system.
7. All control and interlock wiring for the BAS loop cable installed in conduit.
8. All miscellaneous appurtenances, accessories and specialties required for a complete installation placed into satisfactory operating condition.
9. Signs, charts, labels, etc., conforming to the requirements of the specifications.
10. Hot water piping system, circulating pumps and valves.
11. Supply, return, exhaust ventilation systems and air conditioning systems, including fans, air handling units, ductwork, motors, heating coils, dampers, filters, air distribution devices, dampers, and all accessories.
12. Electric unit heaters and electric cabinet unit heaters.
13. Air cooled condensing unit.
14. All drains and drainage systems from HVAC coils, protective drain pans and plenum duct drains.
15. Motor control centers and variable frequency drives (VFD) for the fans, motor starters for all other mechanical equipment specified to be furnished with motors or electrical heaters.
16. Insulation of piping, ductwork, equipment, etc.
17. Painting of equipment and piping, shop finishes, piping identification, stenciling and color coding.
18. Testing, balancing, adjusting, instructions and guarantees.
19. A complete "Air Side Economizer System" including controls.
20. Split system air conditioning units and associated refrigerant piping.
21. Auxiliary steel required for supporting HVAC equipment, ductwork and piping other than those available in the building structure.
22. Directing the location of access doors and panels required in acoustical tile hung ceilings and furnishing of all access doors and panels required in plaster or dry wall ceilings and partitions.

23. Providing template to the General Construction Contractor for housekeeping pads required under for all floor mounted equipment.
24. Vibration and inertia bases for fans, pumps, etc., and vibration isolators for all equipment and piping.
25. Counter flashing around roof penetrations or waterproofed floor penetrations of HVAC ducts and piping. Caulking around sleeves and fire-stopping at all floor and wall penetration of piping and ductwork.
26. Furnishing and setting of sleeves, required for piping or ductwork in walls and/or slabs.
27. Duct cleaning.
28. Testing and Balancing.
29. Power wiring to individual HVAC motors, including conduit, fuses, disconnect switches, control wiring, etc.

2.02 WORK OF OTHER SECTIONS AND/OR TRADES

- A. Following work shall be performed under other Sections:
 1. All concrete and foundation work, including pads and curbs for equipment installation.
 2. Undercutting of doors or louvers in doors.
 3. Weatherproof louvers in outside walls for air intakes and exhaust.
 4. Setting of access doors in walls and ceilings.

2.03 SEPARATION OF WORK BETWEEN CONTRACTS

- A. The specifications for the overall construction delineate various items of work under separate trade headings. The Addendum to the General Conditions sets forth the delineation to the extent that it affects the Work under this Contract.
- B. In the absence of more detailed information, this list shall be taken as a specific instruction to the General Contractor to include the work assigned to it.

- C. Indications that the General Contractor is to perform an item of work means that he is to perform the work corresponding to this Contract only, except as noted elsewhere in the "Remarks", column.
- D. This Contractor shall supply all necessary supervision and coordination information to any other Contractors supplying work to accommodate his work.

END OF SECTION

SECTION 230503 - PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for pipe and pipe fittings in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this section shall include but not limited to the following:
 - 1. Heating water piping.
 - 2. Refrigerant piping.
 - 3. Equipment drains and over flows.
 - 4. Unions and flanges.
- B. Related Sections:
 - 1. Section 230516 - Expansion Fittings and Loops for HVAC Piping
Piping Expansion Compensation: Product requirements for piping expansion compensation devices for placement by this section.
 - 2. Section 230523 - General-Duty Valves for HVAC Piping: Product requirements for valves for placement by this section.
 - 3. Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 4. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
 - 5. Section 230700 - HVAC Insulation: Product requirements for piping insulation for placement by this section.
 - 6. Section 232116 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Gray Iron Threaded Fittings.
 - 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
6. ASME B31.1 - Power Piping.
7. ASME B31.9 - Building Services Piping.
8. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
9. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
6. ASTM B32 - Standard Specification for Solder Metal.
7. ASTM B68 - Standard Specification for Seamless Copper Tube, Bright Annealed.
8. ASTM B75 - Standard Specification for Seamless Copper Tube.
9. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
10. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
11. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
12. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

E. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 54 - National Fuel Gas Code.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes for approval, prior to fabrication or installation.
- B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with IBC requirements.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.

- B. Installer: Company specializing in performing work of this section with minimum ten 10 years documented experience.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 COORDINATION

- A. Coordinate installation of buried piping with trenching.
- B. Reference Section 230500 for additional requirements.

PART 2 - PRODUCTS

2.01 HEATING WATER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 seamless, black.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L hard drawn for sizes 2" and smaller.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

2.02 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
 - 1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.

2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 2. Joints: Solder, lead free, [ASTM B32,] 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.03 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
1. Ferrous Piping: Class 250, malleable iron, threaded.
 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.
- C. Flanges shall be of same weight as the fittings and valves in each service category. Welding neck flanges shall be used with flanged valves, equipment, etc., on welded lines. Galvanized screwed flanges shall be used on galvanized screwed lines. Flanges shall be drilled in conformance with 150 lbs. or 300 lbs. standard and shall be faced and spot-faced. Screwed and loose flanges on brass piping shall be brass. Laps shall be machined on front, back and edge. Screwed flanges shall have faces perpendicular to adjoining pipe

2.04 PIPE FITTINGS

- A. Each pipe fitting shall have cast, stamped, or indelibly marked on it the maker's name or mark, weight, and quality of the product when such marking is required by the approved standard.
- B. Welding fittings shall be of same material and schedule as pipe to which they are welded. Welding fittings including laterals shall be approved factory reinforced to develop full working pressure of connecting piping main. Welding elbows shall be long radius pattern. Welding fittings shall be used exclusively, except as otherwise specified. Weldolets may be used for branches only where branch is two (2) or more nominal pipe sizes smaller than main or riser. All welding "lateral" fittings shall have pressure ratings equal to the pipe with which they are to be used.

Welding fittings shall be of Tube-Turn or Walworth manufacture or approved equal, to conform to ASTM-A-234 specifications.

- C. Nipples shall be extra heavy shoulder type of same material as pipe, close nipples are not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.
- B. Verify trenches are ready to receive piping.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 CONNECTIONS

- A. Copper with solder or brazing joints shall be cleaned bright and properly fluxed. Flux shall be non-corrosive as approved.
- B. Teflon paste shall be used on screwed joints and shall be applied to the male thread only.
- C. In connection to equipment, the manufacturer's recommendation as to pipe size and arrangement shall be followed. Connection to equipment shall be made to permit ready disconnection of equipment with minimum disturbance to adjoining pipe. Screwed or flanged unions shall be used at all equipment at inlet and outlet ends. Piping shall be flanged, or fitted with unions for all sections immediately adjacent to connection of equipment which may require pipe removal to aid in all large tube pulling, coil removal, cleaning etc.
- D. Assembly of the mechanical joint pipe and fittings shall be complete with a torque wrench. Torque to be applied to each bolt shall be between 60 pounds and 90 pounds. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
- E. Flange joints shall be faced true, packed and made up perfectly square and tight. Each flange joint shall be provided with best grade steel bolts

for the specific service and with hexagon nuts. Bolts and nuts shall be dipped in a mixture of graphite and oil, just before installation.

- F. Gaskets shall be ring type, 1/16" thick minimum, similar to Klingerit, Johns-Manville or approved equal, asbestos free.
- G. Where piping is to be installed under related work by other Sections, in connection with work and equipment installed by this Trade, the piping shall be installed by other Sections, this Trade shall make the final connections.
- H. Vents for water systems shall be appropriately valved, 3/4" minimum, and piped over to indirect drains or to locations accessible for draining.
- I. Provide a capped valve at the base of all water risers to accept a hose for drainage.
- J. Miscellaneous drains and overflow from tanks, equipment, piping, relief valves, etc., shall be run to the nearest indirect drain and terminate in an elbow over the drain. Provide drain valves wherever required for complete drainage of piping, including the system side of all pump check valves. Drain lines shall pitch not less than 1" in 40' in direction of flow.
- K. Screwed couplings and shoulder nipples not exceeding 6" in length shall be of same material as pipe but of dimensions conforming to Schedule 80. Close nipples are prohibited.

3.04 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 230700.
- G. Provide access where valves and fittings are not accessible.
- H. Install non-conducting dielectric connections wherever jointing dissimilar metals.

- I. Cap pipe and equipment outlets during construction; keep lines and inside of equipment free of foreign materials.
 - 1. Provide for expansion without warping lines, or dislocating or straining connected equipment beyond allowable stress limits.
 - 2. Install piping to clear building construction and to avoid interference with other work.
 - 3. Conceal piping whenever possible.
- J. Pipe base drains from pumps to open drains; use plugged tees at 90 degree turns.
- K. Provide drain with gate valve for equipment containing water. Pipe to an open drain where such drain is within 50 feet of equipment.
- L. Water Lines:
 - 1. At each low point, provide drain nipple and a 3/4" hose bibb drain or a 3/4" drain valve piped to an open drain.
 - 2. Provide air vents at high points in hot water heating lines.
 - 3. Pitch hot water piping upward in direction of flow or install piping with top of pipes at same level, using eccentric reducers.
 - 4. Insulate pipe joints or valves between dissimilar metals, to prevent dielectric action; use isolating flanges. Dielectric couplings are unacceptable.
- M. Threaded Joints:
 - 1. Make up screw pipe with clean sharp threads and pipe joint cement used on male thread only.
 - 2. Ream ends of pipe and clean out the pipe after cutting.
 - 3. Use graphite paste on threads of cleanout plugs.
 - 4. Provide sufficient number of flanges or unions to disassemble piping without breaking screwed fittings.
- N. Place valves and specialties so as to permit easy operation and access; pack all valves at the completion of the work before final inspection.
- O. Water coils: Provide air venting at top of coil and drainage at bottom of coil with 1/2" gate valves.
- P. Provide cold-water make-up piping between the outlets provided under the Plumbing Work and point of equipment under HVAC Work requiring same. Each connection to be provided with a globe valve, check valve

and vacuum breaker. An anti-siphon check valve, similar to that made by Bidoro Company, may be substituted for the check valve and vacuum breaker. If the Plumbing Drawings show the cold-water make-up piping is equipped with a check valve and vacuum breaker, these may be omitted.

- Q. Vertical sections of main risers in shafts shall be constructed of pipe lengths welded together; do not use mechanical couplings or screwed fittings.
- R. Drawings indicate generally the sizes and locations of pipe lines, but the Construction Manager reserves the right to direct changes in run and details of pipe work as necessitated by site conditions. Piping to be of sizes indicated on the Drawings; size any pipe diameter not shown on the Drawings to be in proportion to the load carried at the same resistance as similar piping, or of sizes as directed by Construction Manager.
- S. Cut piping accurately to measurements established at the Construction Site and work into place without springing or forcing, properly clearing all openings, structural members and other equipment. Overhead piping to run as high as possible under structural members.
- T. Establish invert elevations, slopes for drainage to 1/4 minimum. Maintain gradients.
- U. Slope piping and arrange systems to drain at low points.
- V. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- W. Install piping penetrating roofed areas to maintain integrity of roof assembly.

3.05 ROUTES AND GRADES

- A. Piping shown on the drawings shall be considered as diagrammatic for clearness and may or may not, in all parts, be shown in its true position. This fact does not, in any way, relieve the Contractor from full responsibility for the proper erection of a system of piping in every aspect suitable for the work intended.
- B. Drawings indicate generally sizes and locations of pipelines, but the right is reserved to direct changes in details of pipe work as necessitated by actual conditions. Piping shall be of sizes indicated on drawings. Any pipe size not shown shall be in proportion to the load carried at the same resistance as similar piping, or of size as directed.

- C. Piping shall be accurately cut to measurement established at the construction site and shall be worked into place without springing or forcing, properly clearing openings, structural members and other equipment. Overhead piping shall be run as high as possible under structural members.
- D. Exposed piping shall be run perpendicular and/or parallel to floors, walls, etc. Piping and valves shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.
- E. Piping shall be concealed wherever possible. Piping shall be installed so that same can be drained of all water.
- F. Water mains shall pitch upward in direction of flow.
- G. Fittings of the eccentric reducing type shall be used where change of size occurs in horizontal piping for proper drainage or venting.
- H. Steel pipe bends shall be made of the very best grade open hearth, low carbon steel, leaving a smooth uniform exterior and interior finish. Pipe bends shall be made with seamless steel pipe, having a minimum radius of not less than 5 pipe diameters.
- I. Long-turn fittings shall be used wherever conditions permit.
- J. Piping above grade shall be installed so as to be readily accessible for operation, maintenance, repair or replacement.
- K. Extra heavy nipples for short shoulder type only. Close nipples are prohibited.
- L. No piping or work of any kind shall be concealed or covered until all required tests have been satisfactorily completed and the work has been approved by the Architect and all authorities having jurisdiction.

3.06 INSTALLATION - HEATING PIPING SYSTEMS

- A. Install heating water piping in accordance with ASME B31.9.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install in accordance with NACE RP-01-69.
- C. Install Work in accordance with IBC.

3.07 FIELD QUALITY CONTROL

- A. Test heating water system in accordance with ASME B31.9.

3.08 X-RAY INSPECTION OF WELDED JOINTS AND FITTINGS

- A. Report and inspection data shall be submitted after completion of work and/or remediation of defective welding that have been discovered during inspection and X-Ray testing procedures.
- B. Fifteen percent of welds shall be randomly selected, by the testing agency or the owner, for radiographic testing.
- C. Any weld deemed defective, in the opinion of the certified welding inspection and testing agency, shall be ground out for the full depth and re-welded to the testing agency's satisfaction, at no cost to the Owner.

3.09 CLEANING

- A. After completion, fill, clean, and treat heating water, glycol piping system and chilled water piping system. Refer to Section 232500
- B. After completion, clean and treat all piping. Refer to Section 232500.

3.10 PRESSURE TESTING OF PIPING SYSTEMS

- A. Pay fees for tests and inspections; furnish labor, materials, equipment and any instruments required for the tests.
- B. Perform tests and comply with requirements of the inspecting agency to obtain approval for Using Agency's use of systems and equipment, as a part of the Contract Work.
- C. Replace or repair equipment damaged during testing.
- D. Give advance notice of tests to authorities having jurisdiction.
- E. Replace any materials which fail under testing and replace or satisfactorily repair any other materials or work damaged by the testing or failures.
- F. Do not conceal or insulate any section of piping until testing on that section has been satisfactorily completed and approved.
- G. The Contractor shall provide all temporary valves, blanks and accessories for all piping tests, as part of the Work.
- H. Test Criteria: Make all piping systems tight under the following test conditions:
 - 1. Perform hydrostatic test as specified in "Examination, Inspection and Testing" of ANSI B31.9 code, except that duration of test shall be two hours without pressure drop and that no system shall be tested at less than indicated in Item 3 below.

2. If outside temperature is expected to be at or below freezing temperature, the Using Agency has the option to require that the Contractor test piping by the use of non-corrosive glycol/water mixture.
3. Unless otherwise noted or specified, screwed piping shall be tested under a minimum hydrostatic pressure of 200 psig for a period of 2 hours without fall in pressure gauge reading. Welded, soldered and brazed piping shall be subjected to 150 psig air pressure test and welds inspected by applying soap suds. During the air pressure tests, pinholes shall be rewelded at the direction of the Architect/Engineer. Following the air pressure test, piping shall be subjected to hydrostatic test of 200 psig for a period of 2 hours without fall in the pressure gauge reading.
 - I. Hydrostatic test at 1-1/2 times operating pressure plus soap suds and 200 psig air pressure.
 - J. Operating pressure of water systems, unless noted otherwise, shall be determined by adding pump head (TDH) to building static height, with consistent units.
 - K. Valves, strainers and piping accessories shall be treated as part of the piping system for testing purposes, except for the following items:
 1. Pressure gauges or other sensitive instruments which might be damaged during testing - remove during test and replace after test.
 - L. The "design pressure" for all water piping testing is the shutoff head of the system pumps (as shown on their pumps curves) plus building hydrostatic head.

3.11 SYSTEM REQUIREMENTS

- A. All piping systems and components shall be rated for a minimum design working pressure of 150 psig, unless otherwise noted.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 2. Section 260553 - Identification for Electrical Systems.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Electrical Code
- E. Underwriter's Laboratory

1.03 SUBMITTALS

- A. Product Data: Submit catalog data for each motor furnished. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- B. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- C. The motor nameplate and connection diagram shall be stainless steel and contain the following information:
 - 1. Manufacturers' name

2. Rated volts and full load current
 3. Rated frequency and number of phases
 4. Rated full load speed
 5. Rated temperature rise and rated ambient temperature
 6. Time rating
 7. Rated horsepower
 8. Locked rotor code letter
 9. Motors starting on wye connection and running on delta, shall be marked with the code letter corresponding to the wye connection.
 10. Dual voltage motors which have a different locked rotor KVA on the two voltages, shall be marked with the code letter for the voltage giving the highest locked rotor KVA.
 11. NEMA design letter
 12. Service factor
- D. In general, motors shall be furnished integrally mounted on all items of mechanical equipment.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. All motors shall be UL approved and listed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.01 REQUIREMENTS FOR MOTORS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Cooper Industries Inc.
 - 2. Baldor Electric Co.
 - 3. General Electric Co.
 - 4. Emerson Electrical
- B. Motors 1/2 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 1/2 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. Three-Phase Motors: NEMA MG 1, Design B, premium-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Voltage: 200 volts, three phase, 60 Hz or as indicated on Drawings.
 - 2. Service Factor: 1.15 unless indicated otherwise on Drawings.
 - 3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings or specified. Enclosure for pump motors or motors exposed to weather shall be totally enclosed fan-cooled type.
 - 4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 5. Insulation System: NEMA Class F.
 - 6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
 - 8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing

load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

9. Sound Power Levels: Conform to NEMA MG 1.
10. Efficiency: Premium efficiency motors conforming to NEMA.
11. Inverter Duty Rated for motors controlled by VFD. Fan motors controlled by VFD shall be equipped with shaft grounding rings.
12. Motor weight exceeding 25 pounds shall have lifting eyes.

E. Single Phase Motors:

1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
2. Voltage: 115 volts, single phase, 60 Hz.

F. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.02 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.01 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing motors to remain or are to be reinstalled.

3.02 INSTALLATION

- A. Install motor in alignment with shaft of the drive. Alignment test must be done prior to operating the equipment.
- B. Install engraved plastic nameplates in accordance with Section 260553.
- C. Ground and bond motors in accordance with Section 260526.
- D. Coordinate two-speed motor installation with Division 26.

- E. Provide motor shaft grounding ring (SGR) for motors controlled by Variable Frequency Drive.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION

SECTION 230514 - MOTOR CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This Section includes requirements for motor control in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Variable Speed Drives.
 - 2. Combination disconnect switch/magnetic starter units.
- B. Related Sections:
 - 1. All work shall be subject to the General Conditions and shall comply with applicable requirements of the contract.
 - 2. Requirements of Section 230500 shall also govern work specified herein, together with all applicable paragraphs of other Mechanical sections.
 - 3. Section 260519 – Low-Voltage Electrical Power Conductors and Cable.
 - 4. Section 260533 – Raceways and Boxes for Electrical Systems.

1.02 REFERENCE STANDARDS

- A. Material and Installation shall comply with latest editions of applicable codes, recommended practices and standards, of NEC, NEMA, UL and IBC Code.
- B. Examine the Contract Documents of Division 26 for coordinating work specified under this section.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with general conditions.
- B. The motor nameplate and connection diagram shall be stainless steel and contain the following information:
 - 1. Manufacturers' name
 - 2. Rated volts and full load current

3. Rated frequency and number of phases
 4. Rated full load speed
 5. Rated temperature rise and rated ambient temperature
 6. Time rating
 7. Rated horsepower
 8. Locked rotor code letter
 9. Motors starting on wye connection and running on delta, shall be marked with the code letter corresponding to the wye connection.
 10. Dual voltage motors which have a different locked rotor KVA on the two voltages, shall be marked with the code letter for the voltage giving the highest locked rotor KVA.
 11. NEMA design letter
 12. Service factor
- C. In general, motors shall be furnished integrally mounted on all items of mechanical equipment.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish and install all motors, and furnish all variable speed drives, combination motor starters/disconnect switches, disconnect switches and starters that are required for controlling the HVAC equipment and motors.
- B. Coordinate with Division 26 work for installation of and for proper integration of electrical power wiring with the motors, and equipment that are provided under Division 23.

2.02 VARIABLE FREQUENCY DRIVES

- A. Manufacturers:
 1. Yaskawa.
 2. ABB.
 3. Danfoss.
 4. Or Approved Equal.

B. Variable Frequency Drives (VFD):

1. Where shown on the drawings, adjustable frequency drives 1 through 40 hp shall have the following features:
 - a. The VFDs shall be rated for 208 VAC. The VFD shall provide microprocessor based control for three-phase induction motors. The controller's full load output current rating shall be based on variable torque application at 102° F ambient and 10 kHz switching frequency below 40 Hp and 3.6 kHz 40 Hp and above to reduce motor noise and avoid increased motor losses.
 - b. The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VFDs are not acceptable. Insulated Gate Bipolar Transistors (IGBTs) shall be used in the inverter section. Bipolar Junction Transistors, GTOs or SCRs are not acceptable. The VFDs shall run at the above listed switching frequencies.
 - c. The VFDs shall have an efficiency at full load and speed that exceeds 95% for VFDs below 15 Hp and 97% for drives 15 Hp and above. The efficiency shall exceed 90% at 50% speed and load.
 - d. The VFDs shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.
 - e. The VFDs shall have a one (1) minute overload current rating of 110% for variable torque applications.
 - f. The VFDs shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VFD.
 - g. The VFDs shall limit harmonic distortion reflected onto the utility system to a voltage and current level as defined by IEEE 519 for general systems applications, by utilizing the standard 3% nominal impedance integral ac three-phase line reactor.
 - h. Harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling being the point where the utility feeds multiple customers.

- i. Total harmonic distortion shall be calculated under worst case conditions in accordance with the procedure outlined in IEEE standard 519-1992. The contractor shall provide any needed information to the VFD supplier three (3) weeks prior to requiring harmonic calculations.
- j. The system containing the VFDs shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. .
- k. The VFDs shall be able to start into a spinning motor. The VFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
- l. Standard operating conditions shall be:
 - 1) Incoming Power: Three-phase, 208 Vac (+10% to - 15%) and 50/60 Hz (+/-5 Hz) power to a fixed potential DC bus level.
 - 2) Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
 - 3) Speed regulation of +/- 0.5% of base speed.
 - 4) Load inertia dependant carryover (ride through) during utility loss.
 - 5) Insensitive to input line rotation.
 - 6) Humidity: 0 to 95% (non-condensing and non-corrosive).
 - 7) Altitude: 0 to 3,300 feet (1000 meters) above sea level.
 - 8) Ambient Temperature: -14 to 122 °F.
 - 9) Storage Temperature: -40 to 140 °F.
- m. Control Functions:
 - 1) Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD. The VFDs shall have a 3 line alphanumeric programmable display with

status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

- 2) Standard advanced programming and troubleshooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition the software shall permit control and monitoring via the VFD's RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.
 - a) The operator shall be able to scroll through the keypad menu to choose between the following:
 - (1) Monitor
 - (2) Operate
 - (3) Parameter setup
 - (4) Actual parameter values
 - (5) Active faults
 - (6) Fault history
 - (7) LCD contrast adjustment
 - (8) Information to indicate the standard software and optional features software loaded.
- 4) The following setups and adjustments, at a minimum, are to be available:
 - a) Start command from keypad, remote or communications port
 - b) Speed command from keypad, remote or communications port

- c) Motor direction selection
 - d) Maximum and minimum speed limits
 - e) Acceleration and deceleration times, two settable ranges
 - f) Critical (skip) frequency avoidance
 - g) Torque limit
 - h) Multiple attempt restart function
 - i) Multiple preset speeds adjustment
 - j) Catch a spinning motor start or normal start selection
 - k) Programmable analog output
 - l) Proportional/Integral process controller
- n. The VFDs shall have the following system interfaces:
- 1) Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
 - a) Remote manual/auto
 - b) Remote start/stop
 - c) Remote forward/reverse
 - d) Remote preset speeds
 - e) Remote external trip
 - f) Remote fault reset
 - g) Process control speed reference interface, 4-20mA dc
 - h) Potentiometer or process control speed reference interface, 1-10Vdc
 - i) RS232 programming and operation interface port
 - 2) Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1)

programmable analog output shall be provided, with the following available at minimum.

- 3) Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
 - a) Fault
 - b) Run
 - c) Ready
 - d) Reversing
 - e) Jogging
 - f) At speed
 - g) In torque limit
 - h) Motor rotation direction opposite of commanded
 - i) Over-temperature
- 4) Programmable open collector output with available 24Vdc power supply and selectable with the following available at minimum:
 - a) Fault
 - b) Run
 - c) Ready
 - d) Reversing
 - e) Jogging
 - f) At speed
 - g) In torque limit
 - h) Motor rotation direction opposite of commanded
 - i) Over-temperature
- 5) Programmable analog output signal, selectable with the following available at minimum:
 - a) Output current

- b) Output frequency
- c) Motor speed
- d) Motor torque
- e) Motor power
- f) Motor voltage
- g) DC link voltage
- o. Monitoring and Displays:
 - 1) The VFD's display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
 - a) Run
 - b) Forward
 - c) Reverse
 - d) Stop
 - e) Ready
 - f) Alarm
 - g) Fault
 - h) Local
 - i) Panel
 - j) Remote
 - k) Hand
 - l) Auto
 - m) Off
 - 2) The VFD's keypad shall be capable of displaying the following monitoring functions at a minimum:
 - a) Output frequency
 - b) Output speed
 - c) Motor current
 - d) Motor torque

- e) Motor power
 - f) Motor voltage
 - g) DC-link voltage
 - h) Heatsink temperature
 - i) Total operating days counter
 - j) Operating hours (resetable)
 - k) Total megawatt hours
 - l) Megawatt hours (resetable)
 - m) Voltage level of analog input
 - n) Current level of analog input
 - o) Digital inputs status
 - p) Digital and relay outputs status
 - q) Motor temperature rise, percentage of allowable.
- p. Protective Functions:
- 1) The VFD shall include the following protective features at minimum:
 - a) Overcurrent
 - b) Overvoltage
 - c) Inverter fault
 - d) Under-voltage
 - e) Phase loss
 - f) Output phase loss
 - g) Under-temperature
 - h) Over-temperature
 - i) Motor stalled
 - j) Motor over-temperature
 - k) Motor under-load

- l) Logic voltage failure
 - m) Microprocessor failure
 - n) DC injection braking
- 2) The VFD shall provide ground fault protection during power-up, starting, and running. VFD's with no ground fault protection during running are not acceptable.
- q. Diagnostic Features:
 - 1) Fault History:
 - a) Record and log faults
 - b) Indicate the most recent first, and store up to 9 faults.
- r. The following features are to be included in the VFDs:
 - 1) HMCP or thermal magnetic breaker to provide a code required disconnect means. Operating handle shall protrude the door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. This shall be defeatable by maintenance personnel.
 - 2) Three contactor bypass shall include a drive input disconnect, an VFD input isolation contactor, bypass contactor and an VFD output contactor that is electrically and mechanically interlocked with the bypass contactor. This circuit shall include control logic, status lights and motor overcurrent relays. The complete bypass system Hand-Off-Auto with Inverter-Bypass selector switches, and inverter/bypass pilot lights shall be packaged with the VFD. The unit may be set up for Manual bypass operation upon a VFD trip.
 - 3) Input isolation transformers, separately mounted, with NEMA 1 enclosure.

- 4) Graphical keypad:
 - a) The operator interface shall consist of a LCD keypad located on the front of the VFD. Features shall include:
 - (1) Twelve (12) pushbuttons for selection, display, and modification of the VFD characteristics as follows:
 - (a) Scroll left
 - (b) Scroll right
 - (c) Scroll up/increase
 - (d) Scroll down/decrease
 - (e) Parameter
 - (f) Monitor
 - (g) Page
 - (h) Operate
 - (i) Enter
 - (j) Reset
 - (k) Start
 - (l) Stop
 - b) The keypad LCD panel shall provide a choice of 8 lines of text or a 64x128 pixel graphical display of key waveforms or a combination of both.
 - c) The operator shall be able to scroll through the keypad menu to choose between the following screens:
 - d) Monitor
 - e) Operate
 - f) Parameter setup
 - g) Actual parameter values
 - h) Operating parameter trends
 - i) Menu for selection of parameters for graphical trend display
 - j) Active faults
 - k) Fault history

- l) LCD adjustment
 - m) Info/files selection to indicate the standard software and optional features software loaded
 - 5) Communication card for interface with control system. Coordinate with ATC Manufacturer.
 - 6) Provide an input EMI filter to minimize conducted electrical noise to meet the requirements of IEC 61800-3.
 - s. Enclosure:
 - 1) The VFD enclosure shall be NEMA 1 for indoor and NEMA 3R for outdoor. The VFD shall have complete front accessibility with easily removable assemblies.
 - 2) VFD's shall be located within Motor Control Centers enclosures.
 - t. Spare Parts:
 - 1) The main logic board, keypad and power supply board shall be supplied as spares, one for each different part number supplied.
 - u. The VFD manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.
 - v. Provide all wiring from the VFD to motors, refer to paragraph 2.5 for additional requirements,
- C. Factory Testing:
- 1. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
 - a. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
 - b. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Adjustable Frequency Drive shall trip electronically without device failure.

- c. After all tests have been performed, each VFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.
 - d. After the burn-in cycle is complete, each VFD shall be put through a motor load test before inspection and shipping.
- 2. The manufacturer shall provide three (3) certified copies of factory test reports.

D. Field Quality Control

- 1. Provide the services of a qualified manufacturer's employed Field Service Engineer or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD's on the job site. Sales representatives shall not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.
- 2. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
 - a. Inspection and final adjustments.
 - b. Operational and functional checks of VFDs and spare parts.
 - c. The Contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.
- 3. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

E. Field Testing:

- 1. The VFD manufacturer shall perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE519-1992. A report of the voltage THD and current TDD shall be sent to the engineer. The Contractor shall provide labor, material, and protection as needed to access the test points. The readings shall be taken with all drives and all other loads at full load, or as close as field conditions allow.

F. Training:

1. The Contractor shall provide a training session for up to 6 owner's representatives for 2 normal workdays with a maximum of 2 trips at a job site location determined by the owner. Training and instruction time shall be in addition to that required for start-up service.
2. The training shall be conducted by the manufacturer's qualified representative.
3. The training program shall consist of the following:
 - a. Instructions on the proper operation of the equipment.
 - b. Instructions on the proper maintenance of the equipment.

2.03 SOLID-STATE REDUCED-VOLTAGE MOTOR STARTERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Allen-Bradley.
2. Eaton/Cutler-Hammer.
3. General Electric.
4. Schneider Electric/Square D.
5. Siemens.
6. Or Approved Equal.

B. Reduced Voltage Motor Starters

1. The solid-state reduced-voltage starters shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, and electronic overload relay enclosed in a single molded housing. The bypass contactor shall be housed in the same enclosure as the solid-state starter.
2. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.
3. Units using triacs or SCR/diode combinations shall not be acceptable.

4. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.
5. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
6. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.
7. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current.
8. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
9. The coil shall have a lifetime warranty.
10. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad.
11. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.
12. Starter shall have selectable solid-state electronic overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.
13. Starter shall be capable of either an electronic or mechanical reset after a fault.
14. Units using bimetal overload relays are not acceptable.
15. Over temperature protection (on heat sink) shall be standard.
16. Starters shall provide protection against improper line-side phase rotation as standard. Starter shall shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via a DIP switch on the device keypad.
17. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter shall shut down if a 50% current

differential between any two phases is encountered. This feature can be disabled via a DIP switch on the device keypad.

18. Starter shall provide protection against a motor stall condition as standard. This feature can be disabled via a DIP switch on the device keypad.
19. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via a DIP switch on the device keypad.
20. Starter shall be provided with a form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Over-temp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).
21. The following control function adjustments on the device keypad are required:
 - a. Selectable Torque Ramp Start or Current Limit Start
 - b. Adjustable Kick Start Time, 0-2 seconds
 - c. Adjustable Kick Start torque, 0-85%
 - d. Adjustable Ramp Start Time; 0.5-180 seconds
 - e. Adjustable Initial Starting Ramp Torque; 0-85%
 - f. Adjustable Smooth Stop Ramp Time; 0-60 seconds.
22. Maximum continuous operation shall be at 115% of continuous ampere rating.

C. Enclosures:

1. The enclosures shall be wall mountable NEMA 1 for indoor and NEMA 3R for outdoor installation.
2. Starters shall have a fusible type disconnect device.
3. Fuse clips shall accept only UL Class R fuses.

D. Options:

1. Each starter shall be equipped with HOA selector switch, start-stop pushbutton, red "run" pilot light, green "stop" pilot light and two (2) NO/2 NC auxiliary contacts. Pilot lights shall be LED type.

E. Factory Testing:

1. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
2. The manufacturer shall provide three (3) certified copies of factory test reports.

F. Field Quality Control:

1. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.
2. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
 - a. Inspection and final adjustments
 - b. Operational and functional checks of controllers/starters and spare parts.
3. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

G. Manufacturer's Certification:

1. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
2. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

H. Training:

1. The Contractor shall provide a training session for up to five (5) owner's representatives for 2 normal workdays at a jobsite location determined by the owner.
2. The training representative shall be conducted by a manufacturer's qualified representative.
3. The training program shall consist of the following:

- a. Instructions on the proper maintenance and operation of the equipment.

2.04 MOTOR STARTERS AND CONTROLS

- A. All motor controllers and starters integral shall be in accordance with the following:
 1. All individually mounted motor controllers and starters shall be of the following type:
 - a. Combination fused switch and magnetic controller with solid-state overload protection and low voltage protection.
 - b. Manual toggle switch operation 2 pole or single pole starter with overload protection in approved NEMA enclosure. Where motors are installed remote from starters, provide pilot light.
 2. Provide UL Class RK-1 time-delay, current limiting fuses for all combination starters. Fuses shall be selected based on the fuse manufacturer's motor sizing tables and shall be coordinated with the upstream use or circuit breaker.
 3. Starters shall be NEMA rated contactors with solid-state electronic motor overload protection.
 4. All starters shall be provided with thermal overload protection in all phase legs. Starters for 3-phase motors shall be equipped solid-state electronic overload units, which shall also provide single phase protection. Single phase manual starters shall be equipped with melting alloy overload relays.
 5. Provide all starters with an external overload reset button, mounted in the starter cover.
 6. Provide three-position, maintained contact rotary selector switch (H-O-A) in starter covers for all automatically controlled motors. Pushbuttons are not required where H-O-A switches are used.
 7. Provide 120V control power transformers in all controllers. Control power transformers shall be provided with two primary and one secondary fuse. Fuses shall be UL Class CC time delay type.
 8. Provide all necessary auxiliary contacts and transformers in starters as required. Provide time delay relays for all interlocked motors.
 9. All pilot lights shall be LED type with red or green jewel as indicated. Provide pilot lights where required as follows:

- a. Starters with start-stop pushbutton: 1 pilot light to indicate "Motor On".
 - b. Starters with H-O-A switches: 1 pilot light to indicate "Motor On".
- 10. Each controller, mounted in NEMA type enclosure. Enclosures shall be as follows:
 - a. Exterior: NEMA 4X stainless steel.
 - b. Interior, dry locations: NEMA 1.
- 11. Enclosure sizes and wiring terminals shall be suitable for the use of both copper power and control conductors.
- 12. Starters shall be subject to the approval, as to limit of inrush current, as set up by the Utility Company. In general, magnetic starters shall be located close to the equipment controlled.

2.05 REMOTE DEVICES

- A. Remote pilot light shall be LED type with series resistor.
- B. Wiring shall be connected so as to prevent unintentional starting by the grounding of any wire or wires outside of the starter enclosure.

2.06 FACTORY FURNISHED CONTROL PANELS

- A. The packaged control panel furnished with equipment shall be provided with a circuit breaker and a magnetic starter with three (3) overloads for each motor. The incoming line lugs shall be arranged to accept a single power branch circuit. A control power transformer shall be provided and served via a transfer relay with power taken from the load side of each incoming line circuit breaker.

2.07 POWER FACTOR CORRECTION

- A. All motors, 1-1/2 HP and larger, having a power factor less than 85%, shall be corrected to at least 90% under rated load conditions. By the use of Power factor correction equipment furnished and installed by this section of the work. Power factor corrective devices shall be switched with the motors except where this results in an unsafe condition or interferes with the intended operation of the equipment.

PART 3 - EXECUTION

3.01 GENERAL

- A. Motors installed, not in strict compliance with the above, shall be replaced at no cost to the Owner.

3.02 ELECTRICAL WIRING

- A. Provide all necessary wiring diagrams indicating wire size and connections as required for the proper operation of the equipment. Refer to Division 26 requirements for conduit and conductor requirements.
- B. Contractor shall be responsible for replacing all fuses in the electrical systems during construction which blow due to tests or malfunction of his motorized or non-motorized electrical equipment.
- C. Provide all conduit/power wiring from motors starters, VFD to motor as required for a complete and operational system.

3.03 INSTALLATION

- A. Assembly:
 - 1. Assemble shipping sections and set motor control centers in place level, plumb and in alignment; with channel sills level over their full length on surface of housekeeping pads.
 - 2. Make required mechanical and electrical connections including those indicated on approved shop drawings.
 - 3. Touch-up paint all marred factory finishes.
- B. Overload Elements:
 - 1. Provide in accordance with motor nameplate current, service factor and ambient temperature.
 - 2. With clamp-on ammeter verify loading of motors. Where overloading occurs, do not increase thermal elements unless directed by Architect.

3.04 TESTING

- A. Coordinate testing of starter with testing of the motor and the system associated with the motor.

END OF SECTION

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This Section includes requirements for general duty valves in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Gate valves.
 - 2. Globe valves.
 - 3. Ball valves.
 - 4. Plug valves.
 - 5. Check valves.
- B. Related Sections:
 - 1. Section 230503 - Pipes and Tubes for HVAC Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for pipe hangers and supports.
 - 3. Section 230700 - HVAC Insulation: Product and installation requirements for insulation for valves.
 - 4. Section 230503 – Pipes and Tubes for HVAC Piping and Equipment: Product and installation requirements for piping used in hydronic piping systems.
 - 5. Section 232116 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.
 - 6. Section 232300 - Refrigerant Piping: Product and installation requirements for valves and piping specialties used in refrigeration systems.

1.02 REFERENCES

- A. ASTM International:

1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry:
 1. MSS SP 68 – High Performance Butterfly Valves.
 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- C. Underwriters Laboratories Inc.:
 1. UL 842 - Valves for Flammable Fluids.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC.
- B. All valves shall be designed for a minimum working pressure of 125 psig to 150 psig range unless otherwise noted.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five (5) years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

1.09 EXTRA MATERIALS

- A. Furnish two packing kits for each size valve.

PART 2 - PRODUCTS

2.01 GATE VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Crane Valve, North America.
 - 2. Milwaukee Valve Company.
 - 3. NIBCO, Inc.
 - 4. Stockham Valves & Fittings.
- B. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, non-rising stem, hand-wheel, inside screw with back-seating stem, solid wedge disc, alloy seat rings, threaded ends.
- C. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel

operators for valves 6 inches and larger mounted over 8 feet above floor.

- D. 2 inches and Smaller: MSS SP 80, Class 200, bronze body, bronze trim, union bonnet, rising stem, hand-wheel, solid wedge disc, stainless steel rings, threaded ends.
- E. 2-1/2 inches and Larger: MSS SP 70, Class 200, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.02 GLOBE VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Crane Valve, North America.
 - 2. Milwaukee Valve Company.
 - 3. NIBCO, Inc.
 - 4. Stockham Valves & Fittings.
- B. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, hand wheel, teflon composition disc, threaded ends.
- C. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.
- D. 2 inches and Smaller: MSS SP 80, Class 200, bronze body, bronze trim, union bonnet, rising stem, hand wheel, renewable stainless steel seat ring and disc, threaded ends.
- E. 2-1/2 inches and Larger: MSS SP 85, Class 150 ASTM A216/A216M, cast carbon steel body, bronze trim, bolted bonnet, rising stem hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.03 BALL VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Crane Valve, North America.

2. Milwaukee Valve Company.
 3. NIBCO, Inc.
 4. Stockham Valves & Fittings.
- B. 2 inches and Smaller: MSS SP 110, 400 psi WOG, one piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends, lever handle with balancing stops.

2.04 PLUG VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
1. DeZURIK, Unit of SPX Corp.
 2. Flow Control Equipment, Inc.
 3. Homestead Valve.
- B. 2 inches and Smaller: MSS SP 78, Class 150, semi-steel construction, rectangular port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
- C. 2-1/2 inches and Larger: MSS SP 78, Class 150, semi-steel construction, rectangular port, full pipe area, pressure lubricated, teflon packing, flanged ends. Furnish worm gear-operated.

2.05 CHECK VALVES

- A. Horizontal Swing Check Valves:
1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Crane Valve, North America.
 - b. Milwaukee
 - c. Jamesbury.
 - d. Stockham Valves & Fittings.
 2. Furnish materials in accordance with IBC.
 3. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.

4. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.
5. 2 inches and Smaller for steam applications: MSS SP 80, Class 200, bronze body and cap, Y-pattern, bronze regrinding disc, solder or threaded ends.
6. 2-1/2 inches and Larger for steam applications: MSS SP 71, Class 250, cast iron body, bolted cap, bronze or cast iron disc, flanged ends.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify piping system is ready for valve installation.

3.02 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible.
- F. Refer to Section 23 05 29 for pipe hangers.
- G. Refer to Section 23 07 00 for insulation requirements for valves.
- H. Refer to Section 23 05 03 for piping materials applying to various system types.
- I. Valves shall be installed so they shall be readily accessible. For operation of valves not accessible for direct operation, furnish and install chain wheel, guide and sufficient length of chain to operate from floor level. Provide hooks for fastening chains out of the way. No valve shall be installed with the handle pointing downward. If, in the opinion of the Engineer, valves have been installed so as to create a hazardous and unsafe condition, Contractor shall make corrections as directed, without additional charge.

- J. Valves in Mechanical or Fan Rooms more than 8'-0" above the floor shall be chain operated, with either double end chain wrenches or chain wheels.
- K. Valves 8" and larger shall be provided with a 1" bypass valve of same pressure rating.
- L. Systems shall be supplied with valves in all branch mains, risers, drains, at all pumps, equipment, cooling coils, at all automatic valves and at all apparatus using hot water so located and arranged to give complete isolation and regulating control of the water.
- M. The entire system shall be supplied with valves so located, arranged and operated as to give a complete regulating control to all fixtures and apparatus. Shut-off valves shall be provided on all risers, branch lines, branch lines from mains, mains and at each piece of equipment or fixture. Every section of branch supply and return piping and all risers of all services shall be controlled by a valve at the main. Every item of equipment shall be independently isolated by means of valves.
- N. Valves, except as noted, shall be suitable for a working pressure of not less than 150 psi.
- O. Valves in copper tubing shall have soldered or brazed ends.
- P. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.
- Q. Valve manufacturer's representative shall instruct building operating personnel in proper maintenance of plug valves. Furnish equipment and lubricant for one (1) year service.
- R. Furnish and connect to all valves, brass tags, polished or lacquered with stamp lettering or numbers filled in with black paint. Also furnish a schedule of all valve tags, framed in a polished hardwood frame and covered with plate glass.

3.03 VALVE APPLICATIONS

- A. Valves 2-1/2" size and smaller used for water shutoff shall be ball valve type.
- B. Valves 3" size and larger used for hot or cold water shutoff shall be gate valve.
- C. Valves 2-1/2" size and smaller used for hydronic bypass or for flow control shall be ball valve type. All by pass or flow control valves in steam piping shall be of the globe type.
- D. Valves 3" size and larger used for controlling water flow at pumps and at equipment, and for bypass control shall be lubricated plug type.

- E. Check valves used for water piping, 2" and smaller, shall be all bronze swing check valves with finished bronze trimmings and brazed or threaded ends.
- F. Check valves used for water piping, 2-1/2" and larger, shall be cast iron body, bronze trimmings, swing check valves with flanged ends.
- G. Check valves at discharge of water pumps shall be horizontal or vertical "silent" swing type, 200 psig design.
- H. Gate valves shall be of the solid wedge type and shall be provided with gland and packing boxes, and have top seat for packing under pressure when wide open.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: This Section includes requirements for hangers and supports in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Equipment bases and supports.

B. Related Sections:

1. Section 230503 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
2. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product and execution requirements for vibration isolators.
3. Section 232123 - Hydronic Pumps: Execution requirements for placement of hangers and supports specified by this section.
4. Section 078413 – Penetration Firestopping.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

- B. ASTM International:
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 4. MSS SP 77 -
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.03 SUBMITTALS

A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers. Include the following:

1. Manufacturer's technical literature showing hanger type (per MSS SP-69 Standard) material of construction, loading capacity and installation data.
2. Hanger assembly details, including multiple supports and riser supports.
3. Pipe attachment details for insulated lines.
4. Details of anchors, guides and restraints.
5. Contractor shall submit pull-out strength for all inserts to the structural engineer for review.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit calculations sealed by a registered Architect/Engineer.

D. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Piping Layout Drawings:

1. Provide piping layouts for all HVAC piping systems at same scale as ductwork shop drawings; where such piping is shown on the coordination drawings, separate piping shop drawings for the same area shall also be submitted. Piping shop drawings shall show all hangers and supports, fittings, valves, strainers and accessories. They shall show all sections necessary to establish pipe elevations, shall identify hanger types and loads, and show all tie-

ins to plumbing piping, HVAC equipment and miscellaneous accessories.

- G. Sleeve Layout Drawings: Indicating sleeves in foundation walls, slabs and roofs, grade beams, footings, sound isolation partitions and ceilings.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- B. Perform Work in accordance with IBC.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years [documented] experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Related Sections:
 - 1. Geotechnical Report: Environmental conditions affecting products on site

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Carpenter & Paterson Inc.
 - 2. Anvil (formerly Grinnell).
 - 3. Witch.
- B. Pipe hangers and supports shall comply with the recommendation of Standards SP-58 and SP-69 of the Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, except where otherwise noted in the Specifications or on the Drawings.
- C. The Contractor shall comply with the contractual relationships recommended for the Pipe Hanger Engineer and the Mechanical Contractor, as stated in Standard MSS SP-77 unless otherwise noted in the Contract Documents.
- D. Pipe hangers shall be of the clevis, pipe-roll and pipe-clamp types.
 - 1. Piping subject to lateral or vertical movements shall be provided with supports of the spring hanger type. Refer to Section 230548 "NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT" for Spring Hanger Requirements. No exceptions to this shall be granted.
- E. Pipe hangers shall be connected to the building structure as follows:
 - 1. All water piping 8" and over shall be supported directly from beams or by means of auxiliary steel furnished and installed by this Contractor attached to beams by means of isolation hangers.
 - 2. All other piping may be supported by inserts with sufficient holding capacity to support twice the calculated dead load. No expansion bolts shall be permitted without written permission from the Architect.
- F. Hangers supported from miscellaneous floor steel shall have approved I-beam clamps. I-beam clamps for hangers supporting piping two (2) inches and smaller shall be adjustable side beam clamp. Piping shall be 2-1/2 inches and larger. I-beam clamps shall be Universal forged steel beam clamps with nut right-hand thread.
- G. Provide all auxiliary steel necessary to transmit loads for piping and equipment installed to building beams.

H. Hydronic Piping:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis. Provide cast iron roller for pipes with straight run large than 150 feet.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis cast iron roller.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Cold Pipe Sizes 3 inches and Smaller: Cast iron hooks.
8. Wall Support for Cold Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
9. Wall Support for Hot Pipe, any size: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes 2 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 2-1/2 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
14. Copper Pipe Support: Copper-plated, carbon steel ring.

I. Refrigerant Piping:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Copper-plated carbon-steel ring.
- J. Trapeze and Clevis Hangers:
1. Where two or more lines run parallel and adjacent to each other, trapeze hangers may be used.
 2. Secure pipes supported by trapeze hangers and not mounted on pipe rolls to trapeze with hold down pipe clamps or "J" bolts.
 3. Support vertical piping passing through slabs with pipe clamps installed above slab, unless they are subject to expansion or contraction.
- K. Roller Hangers:
1. Support hot lines (hot water) 2 inches and larger on roller hangers.
- L. Saddles and Shields:
1. Provide protective galvanized shield for supporting insulated lines 1-1/2 inches and smaller.
 2. Provide galvanized saddles and roller hangers for supporting hot insulated lines 2" and larger and hard insulation for supporting cold insulated lines 2" and larger.
 3. Insert insulation identical to pipe insulation in void between saddle and pipe

2.02 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inches in diameter or ducts over 60 inches wide.
- C. In areas where the concrete slab is exposed, inserts shall be installed flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab and provide rod with recessed square steel plate and nut above slab. Under certain conditions, and only with written approval of the Architect, double expansion anchors meet Federal Specification FF-S-325C, as manufactured by HILT1, and having BA&S number may be installed in existing slabs.

2.04 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.05 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Schedule 40 Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Oval and Rectangular Ductwork: Galvanized steel.

2.06 MECHANICAL SLEEVE SEALS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.07 FORMED STEEL CHANNEL

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
- B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.

3.03 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASTM F708, MSS SP 58, MSS SP 69 and MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Provide all necessary hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported

from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing. All hangers and supports shall be capable of screw adjustment after piping is erected with a locking nut provided to prevent loss of adjustment due to pipe vibration. Hangers supporting piping expansion loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot. All supports and components shall be rated for a minimum of two times the calculated dead load.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 23 05 48.

3.06 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.07 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.08 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.09 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.11 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
Up to 1-1/2	6	6	1/2	3/8
2	8	8	1/2	1/2
2-1/2	10	10	5/8	5/8
3	10	10	5/8	5/8
4	-	10	-	3/4

- B. When several pipes rest on a common hanger, increase rod diameter accordingly, and spacing noted above must remain.

END OF SECTION

SECTION 230548 - NOISE AND VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This Section includes requirements for noise and vibration controls for HVAC piping and equipment in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Vibration isolators.
- B. Related Sections:
 - 1. Section 230516 - Expansion Fittings and Loops for HVAC Piping: Product requirements for anchors and piping expansion compensation.
 - 2. Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
 - 3. Section 230593 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.
 - 4. Section 233300 - Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- B. American National Standards Institute:
 - 1. ANSI S1.4 - Sound Level Meters.
 - 2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - 3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 - 4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

- C. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
- D. American Society of Heating, Refrigerating and:
 - 1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 2. ASHRAE Handbook - HVAC Applications.
- E. ASTM International:
 - 1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - 3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.
- F. Sheet Metal and Air Conditioning Contractors':
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork. Reference Section 3 for requirements.
- B. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.
- C. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook., HVAC Applications:
 - 1. Commons: 40

1.04 SUBMITTALS

- A. Shop Drawings: Locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- B. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials,

dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

- C. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- D. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- E. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.
- G. Submit shop drawings for the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection.
 - 1. A complete description of products to be supplied, including product data, dimensions, specifications and installation instructions.
 - 2. Detailed selection data for each vibration isolator supporting equipment, including:
 - a. The equipment identification mark
 - b. The isolator type
 - c. The actual load
 - d. The static deflection expected under the actual load
 - e. The specified minimum static deflection
 - 3. Steel rails, steel base frames and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method and location of equipment attachment bolts.
 - 4. Details required to convey complete understanding of work to be returned

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of acoustic housings and ductwork lagging. Record actual locations of hangers including attachment points.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36 standards and recommendations of ASHRAE 68.
- B. All vibration isolation systems including mountings, and hangers, shall be furnished by the same manufacturer.
- C. The vibration isolation systems shall be designed to achieve an 80% to 95% isolation at the lowest rotational speed of the equipment regardless of the condition of the mounting floor.
- D. The flexible isolators shall be properly adjusted and installed in accordance with the weight distribution of the equipment to provide a stable mounting decoupled system. Each flexible isolator shall be designed and installed so that the equipment support base remains level during deflection. The natural frequency for each support point, based upon the load per isolator and its stiffness, shall not differ by more than plus or minus 10%.
- E. The isolation system shall not cause the equipment to generate any mechanical problem, mechanical failure or misalignment of the couplings and bearings.
- F. Furnish information as may be required to verify that all vibration control equipment shall meet static deflections and percentage of isolation reduction specified for various uses.
 - 1. Should operation of any system cause noise or vibration which is, in the opinion of the Engineer, "objectionable," Contractor shall, at his own expense, make such changes in piping, equipment, etc., as may be necessary to eliminate the objectionable noise or vibration.
 - 2. Should the installation of any equipment or piping transmit the noise to any portion of the structure which is, in the opinion of the Engineer, "objectionable," Contractor shall, at his own expense, install such isolation and make such changes or additions as may be necessary to prevent the transmission of the noise or vibration.
- G. Particular attention is directed to the problem of preventing noise and vibration transmission from Mechanical Equipment Rooms and Fan Rooms to adjacent areas. It is of paramount importance that no noise or vibration emanating from equipment in these rooms be perceptible in adjacent areas. Contractor shall incorporate in his installation all devices and accessories to accomplish this result. Such devices shall include vibration eliminator bases and sound absorber pads, acoustical lining or sound traps at fresh air intake louvers, and other sound insulation, all as may be required.

- H. All electrical connections, drain connections, piping connections, etc., made to equipment which rests on vibration isolators shall be sufficiently flexible to permit the equipment to be properly installed.
- I. When concrete pads are called for to be under isolation, they shall be extended to span at least 2 of the supporting beams and they shall be reinforced with rods or mesh so that the concrete can act as a beam reinforcing the floor and providing a better support for the isolation. The vibration control equipment manufacturer shall submit templates and weight at each support point to the Concrete Section to achieve this.
- J. Where supplementary steel is required to support piping this steel shall be designed to provide a maximum deflection of 0.08 inches at the midspan under the supported load. Piping shall be rigidly supported from the supplementary steel and the supplementary steel isolated from the building structure by means of isolators.
- K. Acoustical Performance Specifications: It is the intent that noise levels due to air conditioning and/or ventilating equipment, ducts, grilles, registers, diffusers and air system pressure reducing devices shall permit attaining sound pressure levels in occupied spaces conforming to the NC as explained in the latest issue of the ASHRAE Guide and Data Book and indicated in 1.03, D.
- L. Design isolators for equipment installed outdoors to provide adequate restraint to withstand the force of a 100 mph wind applied to any exposed surface of the isolated equipment. Isolators for outdoor equipment shall have bolt holes for attachment to equipment and to supports. The vibration isolation Vendor shall submit verifying shear and over turning calculations, for their product and equipment installation arrangement, stamped by a licensed Professional. The design and supply of miscellaneous support steel above and below isolators shall not be the responsibility of the vibration isolation manufacturer.
- M. Static deflection of isolators shall be as provided as noted below. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and shall be disapproved.
- N. Vibration Criteria:
 - 1. Mechanical and electrical equipment operated by motors over one horsepower and unless otherwise noted, and associated piping and ductwork, shall be isolated from the structure by means of resilient vibration and noise isolators supplied by a single manufacturer to the HVAC Contractor. The isolator manufacturer shall include the complete design for the supplementary basis; a tabulation of the design data on the isolators including outside diameter; free, operating and solid heights of the springs; free and

operating heights of the neoprene or fiberglass isolators; and isolation efficiency based on the lowest operating speed of the equipment supported.

2. All rotating equipment shall be balanced both statically and dynamically. The equipment supporting structure shall not have any natural frequencies within $\pm 20\%$ of the operating speeds. The equipment, while operating, shall not exceed a self-excited vibration velocity of 0.10 inches per second when measured with a vibration meter on the bearing caps of the machine in the vertical, horizontal and axial directions, or at the equipment mounting feet if the bearings are concealed.
3. Vibration testing shall be in accordance with procedure established by "Testing Vibration Isolation Systems", Page 52.38 of ASHRAE HVAC Systems and Applications – 1987.
4. When it is determined by the Department that any equipment vibration exceeds the specified level, the contractor in consultation with the Professional shall, at no cost to the Owner, determine the source of the vibration and make the necessary corrections or replacement to reduce it to the acceptable level.

O. Sound Pressure Levels:

1. The sound pressure levels around mechanical and electrical equipment (fans, motors, elevators, transformers, etc.) in equipment spaces shall not exceed 85 dbA at any point, 3 feet from equipment, with all equipment in the room operating. The sound criteria applies to the complete operating range of each piece of equipment.
2. The maximum interior background sound pressure levels for the various usage areas within the building shall be indicated on Table 2, "Recommended Indoor Design Goals for HVAC System Sound Control" – ASHRAE HVAC Systems and Applications – 1987, Page 52.4, or as otherwise specified. Each area, so designated, shall be tested and reported for noise level with all equipment operating and space unoccupied.
3. When equipment or space sound pressure levels exceed the specified criteria, the contractor in consultation with the Professional shall, at no cost to the Owner, determine the source of the noise and make the necessary corrections to reduce it to the acceptable levels.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 FLOOR MOUNTING OF FACTORY ASSEMBLED AIR HANDLING UNITS - MOUNTING TYPE IV

- A. Floor mounted air handling units shall be internally isolated with spring isolators with a minimum of 2" static deflection.
- B. Diagonal hanger rod isolators shall be provided as required to limit horizontal motion to 1/4" maximum.
- C. Units shall be mounted on Mason Industries Super W pads on top of minimum 8" steel channels. Exact quantity of pads shall be determined in accordance with manufacturer's recommendation.

2.02 MOUNTING OF CEILING SUPPORTED FACTORY ASSEMBLED FANS, TUBULAR FANS, AXIAL FANS - MOUNTING TYPE V

- A. Hung by isolation with retainers containing steel springs and neoprene isolator element. Structural sub-base or unit integral supports if adequate as approved by Engineer. Isolators shall be as follows:

Type DNHS	-	M.I.I.
Type VSHL	-	V.M.C.I.
Type TK	-	V.E.C.
- B. Diagonal hanger rod isolators shall be provided as required to limit horizontal motion to 1/4" maximum under fan operating conditions.

2.03 AIR COOLED CONDENSING UNIT

- A. Air cooled condenser shall be resiliently supported on neoprene mountings comprised of 3 layers of 3/4" thick neoprene pads separated by 16 ga steel shims. Pads shall be minimum 50 durometer and shall be selected to provide 15% deflection under maximum rated load.

2.04 DUCTWORK

- A. All sheet metal ducts and air plenums that are within mechanical rooms or within a distance of 50' total duct length of connected vibration-isolation equipment (whichever is longer) shall be isolated from the building structure by Type FN, PCF or HN isolators. All isolators shall achieve 0.1" minimum static deflection. In addition, provide isolators for the following:

- 1. MER

2.05 GRILLES, REGISTERS AND DIFFUSERS

- A. The maximum permissible sound power levels in octave bands of grilles, registers and diffusers when operated in an installed condition per plans and specification, such that the resulting sound pressure levels in occupied spaces shall conform to noise criteria levels as stated in "Acoustical Performance Criteria" hereinbefore described. As a guideline noise level from grilles and diffusers shall be selected to attain NC levels at least 5 NC below stated performance criteria.

2.06 ACOUSTICAL PERFORMANCE WITHIN EQUIPMENT SPACES

- A. Equipment room noise levels and noise transmission to adjacent buildings shall comply with all State and City Noise Ordinances.

2.07 EXTERIOR ACOUSTICAL PERFORMANCE

- A. Outdoor noise levels and noise transmission to adjacent buildings shall comply with all State and City Noise Ordinances.

2.08 MOTOR ACOUSTICAL PERFORMANCE

- A. Motor drives for pumps when installed per plans and specifications shall operate with noise levels not exceeding 90 dba.
- B. Noise levels shall be determined in accordance with IEEE Standard u/85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.02 INSTALLATION

- A. Install isolation for motor driven equipment.
- B. Bases:
 - 1. Set steel bases for 1 inch clearance between housekeeping pad and base.
- C. Adjust equipment level.
- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- G. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- H. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.
- I. All equipment, piping, etc., shall be mounted on or suspended from approved foundations and supports, all as specified herein, as shown on the drawings, or as required.
- J. All floor-mounted equipment shall be erected on 4" high concrete pads over the complete floor area of the equipment, unless specified to the contrary herein. Wherever hereinafter vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be in turn mounted upon 4" high concrete pads unless specified to the contrary herein.
- K. The vibration isolation systems shall be guaranteed to have minimum one inch deflection or as indicated on the schedule or as specified.
- L. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instruction.

- M. The installed vibration isolation system for each floor or ceiling supported equipment shall have a maximum lateral motion under equipment startup or shutdown conditions of 1/4". Motions in excess shall be restrained by approved spring type mountings.
- N. All mounting systems exposed to weather and other corrosive environments shall be protected with factory applied corrosion resistive materials.
- O. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring has reached specified minimum deflection. Springs shall have a reserve deflection of 50% of rated deflection before reaching solid.
- P. Vibration isolation equipment submittal drawings shall include the following information:
1. Isolation mounting deflections.
 2. Spring diameters, compressed spring heights at rated load; solid spring heights, where steel spring isolation mountings are used.
 3. Equipment operating speed.
- Q. Unless noted otherwise, spring isolators shall have minimum static deflection, when operating at their lowest speed, in accordance with the following table:
- | <u>FAN RPM</u> | <u>Minimum Static Deflection, Inches</u> |
|----------------|--|
| 850 or higher | 1" |
| 600 to 850 | 2" |
| 400 to 600 | 3" |
- R. All neoprene isolators shall have a minimum static deflection of 3/8 inch unless otherwise shown.

3.03 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.
- B. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of

artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

- C. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for piping and equipment identification in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Samples: Submit two tags, labels and pipe markers used on project.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color: 2" x 1" x 1/8" thick with 1/4" high characters.

2.02 TAGS

A. Metal Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.
 - b. Brady
 - c. Seton Identification Products
2. Brass with stamped letters; tag size minimum 2 inches diameter with finished edges.

B. Information Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.
 - b. Brady
 - c. Seton Identification Products
2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.03 STENCILS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Craftmark Identification Systems
2. Brady
3. Seton Identification Products

B. Stencils: With clean cut symbols and letters of following size:

1. Ductwork and Equipment: 2 inches high letters.

- C. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.04 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - a. Craftmark Identification Systems.
 - b. Brady
 - c. Seton Identification Products
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.05 LABELS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Craftmark Identification Systems.
 - 2. Brady
 - 3. Seton Identification Products
- B. Description: Aluminum size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Apply stencil painting.
- B. Install identifying devices after completion of coverings and painting.

- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with stencil painting. Identify in-line pumps and other small devices with tags.
- H. Identify control panels and major control components outside panels with nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- N. All valves, fire dampers, fire smoke dampers, piping and other concealed equipment shall be properly tagged with adhesive labels (size, color, font and nomenclature to be submitted and approved by Architect at the exact location where equipment is installed, either on ceiling grid or access door (as applicable).

3.03 SCHEDULES

- A. Provide color-coded valve schedule for each system and enclose in Lexan frame.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for testing, adjusting and balancing for HVAC in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Testing, adjusting and balancing of air systems.
 - 2. Testing, adjusting and balancing of hydronic and refrigerating systems.
 - 3. Measurement of final operating condition of HVAC systems.
 - 4. Sound measurement of equipment operating conditions.
 - 5. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Section 230923 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.
 - 2. Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.02 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.03 SUBMITTALS

- A. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- B. Test Reports: Indicate data on either AABC MN-1 National Standards for Total System Balance forms, forms prepared following ASHRAE 111 or NEBB Report forms.
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or a Copy of NEBB Certificate of Conformance Certification.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in soft cover, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. Reports shall be signed/sealed by a Professional Engineer in the state where the project is located.
- G. Preliminary Effort:
 - 1. Immediately after award of the HVAC Contract, the T&B Contractor shall review the Drawings and Specifications and shall indicate any deficiencies (or additional features) in the air or water systems which would preclude (or improve) proper adjusting or balancing. These include:
 - a. Additional air volume dampers.
 - b. Additional water balance devices.
 - c. Installation of additional air flow measuring devices.
 - d. Installation of additional "Peet's Plugs" ports, etc.
 - 2. Submit for approval sample forms that he intends to use for tabulating balancing reports which shall include fan and pump or other equipment tags or labels. These forms should be similar to the AABC forms or NEBB equivalent.

3. Describe the instrumentation (including accuracy limitations) of each device proposed for use on this project for air and water balancing. As a minimum, instrumentation usage application and accuracy limitations acceptable on this project shall be those described in "HVAC Systems - Testing, Adjusting and Balancing" published by Sheet Metal and Air-Conditioning National Association, Inc. (SMACNA).

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flow measuring stations balancing valves and rough setting.
- B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC.
- B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- C. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.06 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum five (5) years documented experience certified by AABC or Certified by NEBB.
- B. Perform Work under supervision of AABC registered professional engineer experienced in performance of this Work and licensed in State of New Jersey.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place or in normal position.
 - 15. Service and balancing valves are open.

3.02 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Periodic Inspections Of The Project During Construction
 - 1. Prior to commencement of balancing, the T&B Contractor shall make periodic inspections of the project during construction (as noted below) and shall report in writing to the Architect any

deviations from Contract Documents relating to testing, balancing, and adjustment work concerning:

- a. Equipment:
 - 1) Installation
 - 2) Placement
- b. Inaccessible installation of the following balancing hardware:
 - 1) Ports
 - 2) Plugs
 - 3) Balance damper handles
 - 4) Other such items

3.03 EXECUTION

- A. The HVAC Contractor and its selected and approved balancing firm shall report to and review the work required with the Architect prior to beginning of work. At least two (2) one-day inspections of the Water and Air Systems at appropriate times during construction shall be made by the balancing firm and it shall report its findings to the Architect. All openings, pressure taps, wells and closures required, over and above those shown on the drawings, to perform the required test and adjustments shall be installed during or after construction at no additional cost to Department.
- B. The Contractor shall furnish all services for a minimum of two complete adjustments of water systems and air handling and exhaust systems, water and air distribution and controls, for the first cooling season and for the first heating season after the job is in complete operation under load conditions.
- C. During all tests, it shall be demonstrated that the systems are free from leaks and that all parts of the system shall operate correctly. The Balancing firm shall make final adjustments to all equipment and controls as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by the Control Manufacturer's mechanics on the advise of the balancing firm.
- D. The final test report shall include appropriate reference to all problems regarding the system(s) encountered prior to, during and after testing and what action should be taken to correct the problem(s), including noise and vibration.

- E. The following work shall be included by the balancing firm:
1. Supervise the balancing of all water circulation systems and parts thereof installed under this Contract to obtain the water quantities and temperature drops in all parts of the system specified in the plans and in the specifications, or as required by the Professional.
 2. Supervise the balancing of the air conditioning and ventilating systems to achieve the air quantities specified at each air inlet, outlet and damper shown on the plans at the proper conditions of static pressure and temperature differential. Conduct all leakage tests on high (pressure) velocity ductwork in a manner acceptable to the Architect. Leakages shall not exceed 3% of total air to be delivered.
 3. Enlist cooperation of equipment manufacturer where needed to obtain proper equipment performance.
 4. Study and report on noise and vibration problems which may develop in the course of system balancing.
 5. Submit separate reports on the cooling and heating water circulating systems, ATC system, and heating and ventilating systems. These reports shall certify test methods and instruments used, all readings obtained, temperature and pressure drops, RPM of equipment, amperage of all motors, air quantities at each outlet supply, return and air balancing problems encountered, and suggestions. Reports to be submitted to the Architect and the Department shall include data on all tests in the form normally used by AABC and NEEB. The reports must, however, be varied to suit these specifications. Reports shall include fan and pump curves for the final speeds developed from the fan manufacturer's performance test data for all major equipment and schematics for all systems tested.
 6. Perform tests on heating systems when the outside temperature is averaging less than 30°F and on cooling systems when the outside temperature is above 80°F.
 7. Instruct the Building Maintenance employees for a minimum of two weeks during the adjusting and balancing period. Obtain signed statements from each employee verifying this instruction has been received by each.
 8. Carry out the "start-up" of the various systems with the Contractor and with any necessary assistance of the equipment manufacturer's representative.
 9. Furnish all instruments and provide all instrumentation required to perform the above work. The equipment and instrumentation shall

remain the property of the balancing subcontractor, however, all equipment must be first approved by the Architect before being used on the project.

3.04 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- G. Prior to arrival on project, the Contractor shall:
 - 1. Adjust all balancing cocks and dampers open.
 - 2. Fill, vent, and clean all water systems.
 - 3. Place all equipment in operating condition.
 - 4. Clean all strainers.
 - 5. Remove all temporary air filters and install design filters.
- H. For the duration of the balancing work, the Contractor shall:
 - 1. Maintain mechanics at project at all times for system operation, trouble shooting, assistance, etc.

2. Adjust fan drives or blade pitch as required to meet system performance requirements.
 3. Provide necessary mechanical adjustments in conjunction with balancing procedure.
 4. Replace all balancing valves or dampers in systems that cannot be manipulated to satisfy balancing requirements.
- I. Standard size (5" x 8") index cards, i.e. "check-out cards", shall be enclosed in a Vinafilm binder securely attached to each device as per the above.
- J. In cooperation with the Contractor, the T&B Contractor shall check and verify the satisfactory performance of static pressure of mass flow synchronization control loops and the ability of each control loop to hold a set-point and maintain stable fan or flow synchronization control. Operating tolerances for each loop set-point shall be obtained from the Owner.
- K. The T&B Contractor shall use flow meters where they are provided for taking data. This shall include the use of air flow metering stations for air flow measurement in preference to taking data via pitot-static tube traverses of ducts where such devices exist. Where it is necessary to perform pitot-static tube traverses of the duct, the T&B Contractor shall seal test holes with snap-in plugs or he shall use approved caps made for this purpose. The use of tape to seal test holes shall not be allowed.
- L. Maintain specified acoustical performance of air systems; use dampering devices at air terminals to produce pressure drops not in excess of 0.15 in. w.g. for air balance trim.
- M. With all boxes in the duct system set at maximum flow, the fan capacity output and static pressure capability shall be determined by measurement and it shall be recorded. Fan capacity deficiencies shall be noted, recorded and reported to the Owner for corrective action. Duct leakage estimates shall also be noted and recorded and, if in excess of specified allowable reported to the Owner for corrective action.
- N. After satisfactory balance has been achieved, reset the duct system static pressure controller to the lowest set point compatible with scheduled air delivery.
- O. Note and record any box controller limit setting by number where applicable.
- P. If the supply and return air flow serving a particular zone are synchronized for system self-balancing purposes, confirm by measurements the capacity and action of the self balancing control loop to track and maintain differential flow requirements. Instrument signal air supply

pressures shall be recorded where possible, depending upon the control loop's supplier.

- Q. The aim of all balancing adjustments shall be the minimum use of energy for fluid transport.
- R. All fans should be set at their lowest rpm or blade pitch to provide design flow; air dampers are to be used only for final trim.
- S. Contractor shall provide all sheave/drive changes as required to meet specified flow rate.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts. The intent is to utilize minimum site energy and all fan systems should be properly setup to their lowest rpm to achieve design flow rates. Air dampers are to be used for final trim only.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.
- M. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems, after air balancing, to obtain design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.08 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. HVAC Pumps
 - 2. Existing Boilers
 - 3. Air Cooled Condensing Unit
 - 4. Air Coils
 - 5. Terminal Heat Transfer Units

6. Air Handling Units
 7. Fans
 8. Air Filters
 9. Air Inlets and Outlets
 10. Other specified equipment
- B. Report Forms
1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
 3. Instrument List:
 - a. Instrument

- b. Manufacturer
- c. Model number
- d. Serial number
- e. Range
- f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service

- f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
- 7. Sound Level Report:
 - a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
 - d. RC level - equipment on
- 8. Vibration Test:
 - a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (when applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement

- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (when non-complying)

3.09 FINAL APPROVAL

- A. This Contract shall include an extended period of 120 days after submittal of the final certified test report (approved by the Architect) for a given system, during which time the Owner may request a spot check, retest and/or resetting of any outlet or other item as listed in the certified test report; however, this request may not exceed 10% of the outlets or devices on each central system.
- B. If more than 5% of the total devices on a given central system test outside the prescribed limits set for air balance, the Owner shall have the option of revoking the test report and requiring a complete rebalance of the system in question.
- C. If a retest or spot check is requested, the T&B Contractor shall provide technicians and instruments in making any tests required during this period.
- D. Final acceptance shall not be accorded the certified test report until the extended period of 120 days has expired.

END OF SECTION

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: This section includes requirements for HVAC insulation in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. HVAC piping insulation, jackets and accessories.
2. HVAC equipment insulation, jackets and accessories.
3. HVAC ductwork insulation, jackets, and accessories.

1.02 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
4. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
5. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
9. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

10. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 11. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 12. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 13. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 14. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 15. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 16. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 18. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 19. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 20. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
 21. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 22. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 23. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- B. Sheet Metal and Air Conditioning Contractors':
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- C. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Samples: Submit two samples of representative size illustrating each insulation type.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements

1.04 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723 and NFPA 258.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with IBC.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
 - 1. Aeroflex. Aerocell.
 - 2. Armacell, LLC. Armaflex.
 - 3. Nomaco. K-flex.
- C. Furnish materials in accordance with IBC.

2.02 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

5. Density 10 PCF average.
- B. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Operating Temperature Range: 0 to 650 degrees F.
 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
 5. Density 10 PCF average.
- C. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.
1. Thermal Conductivity: 0.27 at 75 degrees F
 2. Operating Temperature Range: 0 to 650 degrees F.
 3. Density 10 PCF average.
- D. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.
- E. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
1. Thermal Conductivity: 0.30 at 75 degrees F.
 2. Maximum Service Temperature: 300 degrees F.
 3. Operating Temperature Range: Range: Minus 58 to 300 degrees F.
- F. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Maximum Service Temperature: 250 degrees F.
 3. Operating Temperature Range: Range: Minus 58 to 250 degrees F.
- G. TYPE P-8: ASTM C547, Type I rigid, mineral fiber preformed pipe insulation, noncombustible.
1. Thermal Conductivity: 0.23 at 75 degrees F.

2. Maximum Service Temperature: 1200 degrees F.
 3. Reinforced Fail Vapor Retarding Jacket: UL listed, with two factory-applied and treated with fire retardant lagging adhesive. ASTM E93.
 4. Consisting of single layer thickness to comply with requirement.
- H. TYPE P-11: ASTM C533; Type I, hydrous calcium silicate pipe insulation, rigid molded white; asbestos free.
1. Thermal Conductivity: 0.45 at 200 degrees F.
 2. Operating Temperature Range: 140 to 1200 degrees F.
 3. Density: 15.0 PCF.

2.03 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 10 mil.
3. Connections: Pressure sensitive color matching vinyl tape.

B. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.016 inch thick sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 3/8 inch thick aluminum.

C. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Blanket: 1.0 lb/cu ft density.

- c. Weave: 10 x 10.
- 3. Indoor Vapor Retarder Finish:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.04 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Steel saddle. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- H. Adhesives: Compatible with insulation.

2.05 EQUIPMENT INSULATION

- A. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied reinforced aluminum foil jacket.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 3.0 pound per cubic foot.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE E-5: ASTM C612; glass fiber, semi-rigid board, noncombustible.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Maximum Operating Temperature: 850 degrees F.
 - 3. Density: 3.0 pound per cubic foot.

- C. TYPE E-7: ASTM C533; Type II, hydrous calcium silicate block insulation, asbestos free.
 - 1. Thermal Conductivity: 0.45 at 200 degrees F.
 - 2. Operating Temperature Range: 140 to 1200 degrees F.
 - 3. Density: 15.0 PCF
- D. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: Range: Minus 70 to 220 degrees F.

2.06 EQUIPMENT INSULATION JACKETS

- A. Aluminum Equipment Jacket:
 - 1. ASTM B209.
 - 2. Thickness: 0.016 inch thick sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- B. Field Applied Glass Fiber Fabric Jacket System:
 - 1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
 - 2. Glass Fiber Fabric:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Blanket: 1.0 lb/cu ft density.
 - c. Weave: 10 x 10.
 - 3. Indoor Vapor Retarder Finish:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.07 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.

2.08 DUCTWORK INSULATION

- A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.25 at 75 degrees F.
 - 2. Maximum Operating Temperature: 250 degrees F.
 - 3. Density: 1.5 pound per cubic foot.
- B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.
 - 1. Thermal Conductivity: 0.22 at 75 degrees F.
 - 2. Density: 4.25 pound per cubic foot.
6.0 pound per cubic foot for outside air intake.

2.09 DUCTWORK INSULATION JACKETS

- A. Membrane Duct Jacket: ASTM D4637; Type I, EPDM; non-reinforced, 0.060 inch thick, 48 inch wide roll; white color.

2.10 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- B. Vapor Retarder Lap Adhesive: Compatible with insulation.
- C. Adhesive: Waterproof, ASTM E162 fire-retardant type.
- D. Liner Fasteners: Galvanized steel, welded with integral head.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Lagging Adhesive: Fire resistive to ASTM E84, NFPA 255 and UL 723.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Adhesives: Compatible with insulation.
- I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify piping, equipment and ductwork have been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems less than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive

adhesive system on standard factory-applied jacket and butt strips or both.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

F. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.
3. Insulate flanges and unions at equipment.

G. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install saddle between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
4. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall be not less than following lengths:

2-1/2 in. pipe size and smaller	6 in. long
3 in. to 6 in. pipe size	9 in. long

H. Insulation Terminating Points:

1. Ducted Coil Branch Piping: Terminate hot water piping at the coil connections including coil header.

2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- I. Closed Cell Elastomeric Insulation:
 1. Push insulation on to piping.
 2. Miter joints at elbows.
 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 4. When application requires multiple layers, apply with joints staggered.
 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- J. High Temperature Pipe Insulation:
 1. Install single layer to meet thickness scheduled. Multiple layers insulation shall not be accepted.
 2. All insulation surfaces not in shaft construction, shall maintain a maximum of 100°F for piping insulation and 130°F for equipment insulation.
 3. Stagger joints between layers.
 4. Supplied with pre-formed jacket.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Aluminum jacket and fitting covers.
- L. Provide finish painting.

3.03 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
 1. Insulate entire equipment surfaces.

2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 4. Finish insulation at supports, protrusions, and interruptions.
- E. Equipment Containing Fluids 140 degrees F Or Less:
1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 2. Install insulation with factory-applied or field applied jackets, with vapor barrier. Finish with glass cloth and adhesive.
 3. Finish insulation at supports, protrusions, and interruptions.
- F. Equipment Containing Fluids Over 140 degrees F Or Less:
1. Insulate flanges and unions with removable sections and jackets.
 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 3. Finish insulation at supports, protrusions, and interruptions.
- G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with aluminum jacket.
- H. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- I. Cover glass fiber, cellular glass, hydrous calcium silicate insulation with metal mesh and finish with heavy coat of insulating cement and aluminum jacket.
- J. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- K. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.
- L. Prepare equipment insulation for finish painting. Refer to Section 09 90 00.

3.04 INSTALLATION - DUCTWORK SYSTEMS

- A. Duct dimensions indicated on Drawings are finished inside dimensions unless otherwise noted.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor retarder jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.
- E. External Glass Fiber Duct Insulation:
 - 1. Secure insulation with vapor retarder jacket with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
 - 2. Secure insulation without vapor retarder with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- F. Duct and Plenum Liner:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.
6. Provide metal moorings at section joints.

G. Prepare duct insulation for finish painting.

3.05 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Condensate Piping from Cooling Coils	P-5	All sizes	0.75
Refrigerant	P-5	Up to 1-1/2 inches	1.0
Refrigerant	P-5	2 inches and up	1.5

B. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Heating Water Supply and Return 141 to 200 degrees F	P-1	1-1/2 inches and smaller	1.0
		2 inches to 8 inches	2.0
Drain Piping	P-1	All sizes	1

C. Equipment Insulation Schedule:

EQUIPMENT	INSULATION TYPE	INSULATION THICKNESS inches
Hot Expansion Tanks and Air Separators	E-2	1.5

D. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Outside Air Intake	D-2	2
Equipment Casings	D-2	2
Supply Ducts located above hung ceilings that are not internally insulated	D-1	1.0
Return Ducts located above hung ceilings that are not in return air plenum or are located in shaft	D-1	1.0
Supply ducts in MER's and exposed to view	D-2	1.5
Spill/exhaust ducts from louver to motorized damper	D-2	1.5
Exterior to building on roof	D-2	2.0
Exhaust Ducts Within 20 feet of Exterior Openings [Thickness indicated is installed thickness.]	D-2	1.5
Exhaust Ducts Exposed to Outdoor Air	D-2	2.0
Rectangular and Round Supply Ducts (externally insulated)	D-1	1.0

Refer to Section 230548 "NOISE AND VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT" for specific applications of internally insulated ducts

END OF SECTION

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: This section includes requirements for instrumentation and control for HVAC in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Control panel enclosures.
2. Thermostats.
3. Time clocks.
4. Alarm system.
5. Control air dampers.
6. Electric damper actuators.
7. Control valves.
8. Electric valve actuators.
9. Outside air measuring and modulation device.
10. Direct digital control system components.
11. Duct-mounted smoke detector.
12. Differential pressure monitor.

B. Related Sections:

1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.
2. Section 230903 - Direct-Digital Control System for HVAC.
3. Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
4. Section 232116 - Hydronic Piping Specialties: Product requirements for thermometer sockets and gage taps for placement by this section. Installation requirements for piping products furnished in this section.

5. Section 233300 - Air Duct Accessories: Product requirements for duct mounted thermometers. Installation requirements for dampers and other duct mounted products furnished in this section.
6. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections specified by this section.
7. Section 260533 – Raceways and Boxes for Electrical Systems for Conduit and Box Requirements.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
- C. American Society of Mechanical Engineers:
 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASTM International:
 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 3. ASTM B32 - Standard Specification for Solder Metal.
 4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- E. American Welding Society:
 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. National Fire Protection Association:
1. NFPA 72 - National Fire Alarm Code.
 2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.
- B. Product Data: Submit description and engineering data for each control system component. Include sizing as required.
- C. Samples: Submit two (2) of each type of room thermostat and cover, thermostat guard and each exposed control component.
- D. Manufacturer's Installation Instructions: Submit installation requirements for each control component.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.
- B. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.05 QUALITY ASSURANCE

- A. Control Air Damper Performance: Test in accordance with AMCA 500.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept controls on site in original factory packaging Inspect for damage.

1.09 COORDINATION

- A. Coordinate installation of control components in piping systems with work of Section 23 21 16.
- B. Coordinate installation of control components in duct systems with work of Section 23 33 00.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of control system for one (1) year from Date of Substantial Completion.
- B. Furnish complete service of controls systems, including callbacks. Perform minimum of four (4) complete normal inspections of approximately eight (8) hours duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- C. Furnish four (4) complete inspections per year to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- D. Examine unit components bi-monthly. Clean, adjust, and lubricate equipment.
- E. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- F. Perform work without removing units from service during building normal occupied hours.
- G. Provide emergency call back service at all hours for this maintenance period.
- H. Maintain an adequate stock of parts locally, for replacement or emergency purposes. Ensure personnel availability to ensure fulfillment of this maintenance service without unreasonable loss of time.

- I. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.
- J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

PART 2 - PRODUCTS

2.01 CONTROL COMPONENT MANUFACTURERS

- A. Manufacturers:
 - 1. Johnson Controls.
 - 2. Automated Logic.
 - 3. Honeywell, Building Control Solutions.

2.02 CONTROL PANEL ENCLOSURES

- A. Furnish for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face. Provide control panel enclosure for all devices.
- B. Construction: NEMA 250, Type 4 steel stainless steel enclosure.
- C. Covers: Continuous hinge, held closed by flush latch operable by key.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.03 HUMIDISTATS

- A. Duct Humidistats:
 - 1. Insertion, proportioning type.
 - 2. Throttling range: Adjustable, 2 percent, relative humidity.
 - 3. Operating range: 20 to 80 percent.
 - 4. Maximum temperature: 150 degrees F.
- B. Limit Duct Humidistat:
 - 1. Insertion, two-position type.
 - 2. Throttling range: Adjustable 2 percent relative humidity.
 - 3. Operating range: 20 to 80 percent.

4. Maximum temperature: 150 degrees F.

2.04 THERMOSTATS

A. Outdoor Reset Thermostat:

1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
2. Scale range: -10 to 70 degrees F.

B. Immersion Thermostat: Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.

C. Air-stream Thermostats:

1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
2. Averaging service remote bulb element: 20 feet.
3. Furnish with flange and shield.

D. Electric Low Limit Duct Thermostat:

1. Snap acting, single pole, single throw, automatic reset switch tripping when temperature sensed across any 12 inches of bulb length is equal to or below set point.
2. Bulb length: Minimum 20 feet.
3. Furnish one thermostat for every 20 sq. ft of coil surface.

E. Electric High Limit Duct Thermostat:

1. Snap acting, single pole, single throw, automatic reset switch tripping when temperature sensed across any 12 inches of bulb length is equal to or above set point.
2. Bulb length: Minimum 20 feet.
3. Furnish one thermostat for every 20 sq. ft of coil surface.

F. Fire Thermostats:

1. UL labeled, factory set in accordance with NFPA 90A.
2. Normally closed contacts, manual reset.

2.05 TIME CLOCKS

- A. Seven-day programming switch timer with synchronous timing motor and seven-day dial. Continuously charged Ni-cad battery driven for power failure with 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals each day with two normally open and two normally closed output switches.
- B. Solid-state programmable time control with three (3) separate programs, 24 hour battery carry over duty cycling, 365 day calendar with 20 programmable holidays and choice of fail safe operation for each program and system fault alarm.

2.06 ALARM SYSTEM

- A. Enclosure Construction: NEMA 250, Type 4.
- B. Furnish alarm panel with individual indication, horn, silenced acknowledge switch, and test switch.
- C. At alarm condition indication, light flashes and alarm sounds. Horn stops when acknowledge switch is pushed and system indicates alarm conditions by continuous light until trouble condition has cleared. Alarm sounds again when second alarm occurs before first one has cleared.
- D. Furnish remote panels with duplicate functions of primary panel. Furnish alarm silence/acknowledge switch to acknowledge alarm from each panel.
- E. Furnish dry contacts at main alarm panel for use with remote alarm monitoring system to indicate [each] alarm condition.

2.07 CONTROL AIR DAMPERS

- A. Performance: Test in accordance with AMCA 500.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage gage.
- C. Blades: Galvanized steel one-piece aerofoil blade, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage gage, attached to minimum 1/2 inch shafts with set screws.
- D. Blade Seals: Neoprene mechanically attached, field replaceable.
- E. Jamb Seals: Stainless steel spring.
- F. Shaft Bearings: Lubricant free, stainless steel, single row, ground, flanged, radial, anti-friction type with extended inner race.

- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Outside Air Damper Leakage: Maximum leakage rate of 3.0 cfm per square foot at 1.0 inches wg pressure differential.
- I. Maximum Pressure Differential: 6 inches wg.
- J. Temperature Limits: - 40 to 200 degrees F.

2.08 ELECTRIC DAMPER ACTUATORS

- A. Operation: Two-position or Reversing type proportional motor with spring-return as indicated in contract sequences of operation.
- B. Enclosure Rating: NEMA 250 Type 4.
- C. Mounting: Direct mount.
- D. Stroke: 90 seconds end to end full stroke, 15 seconds return to normal for spring return.
- E. Protection: Electronic stall protection.
- F. Control Input: 0-10 VDC or 0-20 mA DC.
- G. Power: Nominal 24 volt AC.
- H. Torque: Size for minimum 150 percent of required duty.
- I. Duty cycle: rated for 65,000 cycles.
- J. Accessories:
 - 1. Cover mounted transformer.
 - 2. Auxiliary potentiometer.
 - 3. Damper linkage.
 - 4. Direct drive feedback potentiometer.
 - 5. Output position feedback.
 - 6. Field selectable rotational, spring return direction, field adjustable zero and span.
 - 7. End switch.

2.09 CONTROL VALVES

- A. All control valves shall be fully proportioning, unless otherwise specified, quiet in operation and shall be arranged to fail safe, in either a normally open or normally closed position, in the event of power failure. The open

or closed failure position shall be as specified or as required to suit process conditions. All heating valves shall be fail open; all cooling valves shall fail closed. Provisions shall be made for valves operating in sequence, with other valves or dampers, to have adjustable operating ranges and starting points to provide flexibility and adjustment in sequencing and throttling range.

B. Performance Requirements

1. Valves are to be sized and guaranteed to meet the requirements as specified and as indicated on the Drawings.
2. Unless otherwise specified, the following performance requirements shall be used for valve sizing:
 - a. All control valves shall have a manual override.
 - b. Flow Rates:
 - 1) Normal flow rate: See equipment schedule on Drawings.
 - 2) Minimum flow rates: 20:1 turndown for heat transfer equipment; 5:1 turndown for pump discharge throttling and for pressure reducing stations.
 - 3) Maximum flow rate: To be considered only where specified or shown on the Drawings.
 - c. Pressure Drops:
 - 1) The control valve operator shall be sized to shutoff against a differential pressure equal to the pump design head plus 30%.
 - 2) Flowing pressure drop at design conditions: If not indicated on the drawings or in the Specifications, use 5 psi.
 - d. Cavitation:
 - 1) Valve selections shall be free of cavitation over the whole range of performance. Obtain relevant upstream pressure for each valve prior to valve selection, and include the documentation for the cavitation check in the shop drawing submittal.
 - 2) All valves shall be checked for cavitation and noise during their shop drawing review. If these valves show light incipient cavitation, they may be approved, but only after consultation with the local application

engineer. Any valve which suffers critical or damaging cavitation shall be disapproved outright.

e. Ports and Trim:

- 1) Control valves shall be single-seated and shall have equal percentage flow characteristics.

f. All valves shall have electric/electronic actuation

C. Butterfly Valves:

1. Service Pressure Rating: 125 psig at 250 degrees F.
2. Construction: ASTM A126 cast-iron or ASTM A536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
3. Body Style: Wafer, or Lug.
4. Disc: Stainless steel.
5. Resilient replaceable seat for service to 250 degrees F.
 - a. Size for 1 psig maximum pressure drop at design flow rate.
6. Butterfly valves shall only be used for isolation purposes. These valves shall match pipe size that they are located in.

D. Characterized Control Valves

1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.
2. Pressure Independent Control Valves
 - a. Manufacturers:
 - 1) Belimo Aircontrols (USA), Inc.
 - 2) Flow Control Industries
 - b. The modulating control valves shall be pressure independent.
 - c. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than $\pm 5\%$ due to system pressure fluctuations across the valve with a minimum of 5 PSID across the valve.

- d. Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.
- e. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSID.
- f. The control valve shall require no maintenance and shall not include replaceable cartridges.
- g. All actuators shall be electronically programmed by use of a handheld programming device or external computer software. Programming using actuator mounted switches or multi-turn actuators are NOT acceptable. Actuators for 3-wire floating (tri-state) on ½" – 1" pressure independent control valves shall fill in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow. Actuators shall be provided with an auxiliary switch to prove valve position.
- h. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory via a single screw on a four-way DIN mounting base.
- i. The control valve shall require no maintenance and shall not include replaceable cartridges.
- j. The manufacture shall warrant all components for period of 5 years from the date of production, with the first two years unconditional.
- k. The use of pressure independent valves piped in parallel to achieve the rated coil flow shall be permitted. Actuators shall be electronically programmed to permit sequencing the flow with a single control output point. The use of external devices to permit sequencing is NOT acceptable.

2.10 ELECTRIC VALVE ACTUATORS

- A. Fully factory assembled. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under every condition.
- B. Motor: Permanent split-capacitor or shaded-pole type. Gear trains completely oil immersed and sealed. Furnish spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

- C. Actuator: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. Furnish actuator with rating of not less than twice thrust needed for actual operation of valve.
1. Coupling: V-bolt and V-shaped, toothed cradle.
 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 3. Fail-Safe Operation: Mechanical, spring-return mechanism. Furnish external, manual gear release on non-spring-return actuators.
 4. Furnish spring-return actuators with manual override. Complete manual override to take no more than 10 turns.
 5. Power Requirements:
 - a. Two-Position Spring Return: 24 volt AC or DC, maximum 10 vA.
 - b. Modulating: 24 volt AC, maximum 15 vA.
 6. Proportional Signal: 2 to 10 volt dc or 4 to 20 mA, and 2 to 10 volt dc position feedback signal.
 7. Temperature Rating: minus 22 to 140 degrees F.
 8. Run Time: 200 seconds open, 40 seconds closed.
 9. Actuators shall be quiet in operation.
- D. Size for torque required for valve close-off at maximum pump differential pressure, regardless of water loop system pressures.

2.11 OUTSIDE AIR MEASURING AND MODULATION DEVICE

- A. Factory assembled damper, airflow monitor, actuator, and accessories. Provide for each air handling system.
- B. Damper and airflow measurement assembly sized to accommodate minimum outside airflow as indicated on Drawings.
- C. Construction:
1. Frame: Extruded aluminum.
 2. Blades:
 - a. Modulating Air Control:
 - 1) Style: Airfoil-shaped, single-piece.
 - 2) Action: Parallel.

- 3) Orientation: Horizontal.
 - 4) Material: Heavy gage 6063-T5 extruded aluminum.
 - 5) Width: Maximum 5 inches.
- b. Stationary Sensing:
 - 1) Style: Airfoil-shaped, single-piece.
 - 2) Orientation: Horizontal.
 - 3) Material: Heavy gage 6063-T5 extruded aluminum.
 - 4) Width: Maximum 5-1/4 inches.
 - 5) Finish: Anodized.
3. Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.
4. Seals:
 - a. Blade: Extruded rubber. Mechanically attached to blade edge.
 - b. Jamb: Stainless steel, flexible metal compression type.
 - c. Linkage: Concealed in frame.
 - d. Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade.
 - e. Mounting: Vertical.
 - f. Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.
5. Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.
6. Air Straightener Section: 3 inches deep section contained in 5 inch long sleeve attached to damper-airflow monitor frame.
7. Finish: Mill aluminum.
- D. Performance Data:
 1. Temperature Rating: Withstand -40 to 140 degrees F.
 2. Accuracy: Plus or minus 5 percent.

3. Leakage: Maximum of 2 cfm per square foot at 1.0 inches wg pressure differential.
4. Measures from 15 percent to 100 percent of unit's nominal outdoor air flow. Unit shall operate at velocities as low as 200 fpm.
5. Adjusts air flow for temperature variations.
6. Provides 2 to 10 volt DC signal corresponding to actual air flow.

E. Accessories:

1. Actuator Heater: Allow actuator operation in ambient temperatures to -40 degrees F.

2.12 Air Flow Monitoring Stations

A. Fan Inlet Airflow Traverse Probes:

1. Provide on all fans, airflow traverse probes mounted in the fan inlets capable of continuously measuring the air handling capacity (air volume) of the respective centrifugal or vane-axial fan(s).
2. The fan inlet airflow traverse probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probe and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows.
3. The fan inlet airflow traverse probes (two per inlet) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings, and shall be of aluminum construction with hard anodized finish.
4. The fan inlet airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level within the system be amplified by its presence in the fan inlet bell. The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.

B. Air flow measuring stations shall be provided at points indicated on the mechanical drawings and control diagrams with careful attention paid to upstream and downstream straight run requirements for proper installation. Vendor requirements for AMU installation shall be carefully followed.

- C. Each air flow measuring station shall be fabricated of a heavy gauge galvanized steel casing with 90 degree connecting flanges in a configuration and size approximating that of the duct or opening in which it is to be mounted. Each station shall be complete with aluminum flow straightener, copper symmetrical total and static pressure sensors and self averaging manifolds, internal piping, and external pressure transmission ports with flexible tubing and quick-connect fittings. An identification label shall be placed on each station casing, listing model No., size, area, design flow, and differential pressure at design flow.
- D. The maximum allowable pressure loss through the station shall not exceed 0.05 inches w.g. at 1500 fpm, or 0.20 inches w.g. at 3000 fpm. The sound level within the duct shall not be amplified (nor shall additional sound be generated by the air measuring unit). Each station shall be capable of measuring the airflow rate within an accuracy of 2% as determined by U.S. - G.S.A. Certification Tests, and shall contain a minimum of one total pressure sensor per 36 square inches of station measuring area.
- E. Each air flow measuring station shall be furnished with an electronic differential pressure transmitter capable of transmitting a 4 to 20 mA DC output signal. Accuracy shall be $\pm 0.5\%$ of span including linearity, hysteresis and repeatability. Repeatability shall be $\pm 0.05\%$ of span. Each transmitter shall have a 1" x 2" stainless steel tag permanently attached with screws with the tag number, design flow, and the differential pressure at design flow permanently engraved on its surface.
- F. Each air flow measuring station shall be furnished with a local differential pressure gage calibrated to full range with graduations in both inches W.C. and in CFM. Dwyer magnehelic 2000 series.
- G. Static Pressure Sensors/Transmitters - Air Side:
 - 1. Duct static pressure sensors shall consist of a sensing tube, transmitter and electrical box for wiring connections.
 - 2. Two wire transmitter shall provide 4-20 mA DC output linear over specified pressure range.
 - 3. Wiring connections shall accept 16 AWG wire.
 - 4. Calibrated end to end accuracy shall be $\pm 0.25\%$ of full range, including linearity, hysteresis, and repeatability.
- H. Outdoor Air Monitoring Systems:
 - 1. General:
 - a. The outside air flow measuring system shall be capable of measuring the outdoor air flow for the Air Handling Unit.

2. Description:

- a. The panel serves as a central station processor and transmitter for a variety of sensors. Each panel has its own dedicated microprocessor with a four-line, 80 character, alpha-numeric display and full function keypad. The panel is fully programmable and when used with Ebtron's satellite, air flow/temperature sensors can be the central point for air handler sensing.
- b. A 120 volt AC power connection shall be provided by the Controls Contractor, to the IAQ Enforcer panel which supplies all of the system sensors. Satellites sensors require only a single, unshielded, 3-conductor cable which can be "daisy chained" between sensors for simple field installation.
- c. The analog output signals to the Control System shall be 4-20mA DC, or 0-10MV, coordinate with Siebe.

3. Sensor:

- a. Airflow/temperature sensing satellites are comprised of one or more insertion probe assemblies per satellite (duct) location. The flow sensor uses thermal, temperature compensated, thermistor sensing technology and digital electronics.
 - b. The mounting of the outside air probes shall be coordinated with the sheet metal contractor, in accordance with the manufacturer's recommendations.
 - c. Sensors shall be suitable for velocities down to 200 FPM.
 - d. Flow transducers shall be bi-directional where flow in either direction is required.
 - e. The flow transducer accuracy shall be $\pm 2\%$ of reading over middle 80% of operating range.
- I. Where the air flow measuring stations are installed in insulated ducts, the air flow passage of the station shall be same size as the inside airflow dimensions of the duct.
1. Station flanges shall be 2 to 3 inches to facilitate matching connecting ductwork.
 2. Rating: 50 to 5000 fpm, shall have fused input and output.
 3. Manufacturers:
 - a. Ebtron.

- b. Sierra Instruments.

2.13 DIRECT DIGITAL CONTROL SYSTEM COMPONENTS

A. Temperature Sensors:

1. Type: Resistance temperature detector (RTD) or thermistor.
2. Accuracy:
 - a. Plus or minus 1 degree F for standard applications. Where high accuracy is required, furnish accuracy of plus or minus 0.2 degrees F.
 - b. Sensing Accuracy: Plus or minus 0.5 degree F.
 - c. Display Accuracy and Resolution: Minimum of plus or minus 1 degree F.
3. Built-in communications port.
4. Space Sensors:
 - a. Office space.
 - 1) Integral display, day-night override button, and set point slide adjustment override options. Set point slide adjustment capable of being software limited by automation system to limit amount of room adjustment. Honeywell Model # T7412
 - b. Commons Area:
 - 1) Non adjustable tamperproof sensor, Honeywell Model # C7772A-E
5. Outside Air Sensors: Watertight inlet fitting, furnish with shield from direct sunlight.
6. Duct Temperature Sensors:
 - a. Rigid or averaging type as indicated in sequence of operations. Averaging sensor minimum length: 5 feet in length.
 - b. Duct Cross Sections Greater Than 10 square feet: Furnish serpentine averaging element to sense stratified air temperatures.
7. Piping Temperature Sensors: Furnish with separable brass well.

8. Liquid immersion temperature:
 Temperature monitoring range +30/250°F
 Output signal Changing resistance
 Accuracy at Calibration point $\pm 0.5^\circ\text{F}$
9. Duct (single point) temperature:
 Temperature monitoring range +20/120°F
 Output signal Changing resistance
 Accuracy at Calibration point $\pm 0.5^\circ\text{F}$
10. Duct Average temperature:
 Temperature monitoring range +20° $\pm 120^\circ\text{F}$
 Output signal 4 – 20 mA DC
 Accuracy at Calibration point $\pm 0.5^\circ\text{F}$
 Sensor Probe Length 25' L

B. Humidity Sensors:

1. Type: Capacitance or bulk polymer resistance.
2. Drift: Not to exceed 3 percent of full scale per year.
3. Room Sensors:
 - a. Sensing Range: 0 to 100 percent.
 - b. Accuracy of plus or minus 5 percent relative humidity.
4. Duct Sensors:
 - a. Sensing Range: 0 to 100percent.
 - b. Accuracy of plus or minus 5 percent relative humidity.
 - c. Furnish with sampling chamber.
 - d. Element guard.
 - e. Mounting plate.
5. Outdoor Air Humidity Sensors:
 - a. Sensing Range: 20 to 95 percent relative humidity.
 - b. Suitable for ambient conditions of minus 40 to 170 degrees F.
 - c. Accuracy: Plus or minus 2 percent relative humidity at 77 degrees F.

- d. Element guard.
 - e. Mounting plate.
- C. Differential Pressure Switches:
 - 1. Furnish as specified in sequences of operation for status purposes in air and water applications.
 - 2. Fully adjustable differential pressure settings.
 - 3. UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum).
 - 4. NEMA 250 Type 1 enclosure.
 - 5. Scale range and differential suitable for intended application.
- D. Static Pressure Sensor:
 - 1. Non-directional sensor with suitable range for expected input, and temperature compensated.
 - 2. Accuracy: plus or minus 1 percent of full scale with repeatability of 0.5 percent.
 - 3. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
 - 4. Building Static Pressure Range: minus 0.1 to 0.1 inches water column, minus 0.25 to 0.25 inches water column, minus 0.5 to 0.5 inches water column, minus 1.0 to 1.0 inches water column, jumper selectable.
 - 5. Duct Static Pressure Range: 0 to 1 inches water column, 0 to 2.5 inches water column, 0 to 5 inches water column, 0 to 10 inches water column, jumper adjustable.
- E. Liquid Differential Pressure Transmitter:

Ranges	0-5/30 inches H2O 0-25/150 inches H2O 0-125/750 inches H2O
Output	4 – 20 mA DC
Calibration Adjustments	Zero and span
Accuracy	±0.2% of span
Linearity	±0.1% of span
Hysteresis	±0.05% of span

- F. Static Pressure Sensors:
 - 1. Differential pressure type.
 - 2. Sensor range closely matched to system static pressure, minus 0.5 to 0.5 inches water column, minus 1 to 1 inches water column or 0 to 2.5 inches water column.
 - 3. Accuracy: Plus or minus 5 percent of sensing range.
- G. Carbon Dioxide Sensors:
 - 1. Sensors designed for indoor carbon dioxide levels in accordance with ASHRAE Standard 62.
 - 2. 4 to 20 ma. linear output over range of 0 to 2000 ppm of carbon dioxide for interface to DDC control system.
 - 3. For duct mounted sensors furnish airtight enclosure complete with sampling tube.
- H. Air Flow Switches:
 - 1. Paddle or differential pressure type, as indicated in sequences of operation.
 - 2. UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum).
 - 3. Appropriate scale range and differential adjustment.
 - 4. Adjustable sensitivity.
 - 5. NEMA 250 Type 1 enclosure.
- I. Water Flow Switches:
 - 1. Paddle type with stainless steel or bronze paddle.
 - 2. UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum).
 - 3. Appropriate scale range and differential adjustment.
 - 4. Adjustable sensitivity.
 - 5. NEMA 250 Type 1 enclosure.
 - 6. Furnish vapor proof type for chilled water applications.

- J. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180 degree field of view with vertical sensing adjustment, for flush mounting.
- K. Flow Measurement - Waterside
 - 1. Onicon Flow Measurement:
 - a. The hot water and chilled water flow measurement systems shall be a Onicon F-1210 Dual Turbine, or approved equal.
 - b. The flow measurement system shall run on a 115 VAC power source.
 - c. Accuracy shall be $\pm 0.25\%$ of actual value. Linearity shall be $\pm 0.1\%$ of actual value. Rangeability: 100 - 1.
 - d. Output shall be 4-20mA DC linear over calibrated range.
 - e. The flow measurement system shall be in accordance with the P&ID's.
 - 2. Straight Run Requirements:
 - a. Manufacturer's recommendations shall be carefully adhered to with respect to straight run requirements to obtain specified accuracies.
 - b. Submit for approval, location of flow elements in piping clearly indicating upstream and downstream straight run dimensions.
 - 3. Tagging:
 - a. Each flow element shall have a 1" x 2" stainless steel tag either permanently attached with screws or attached with a six inch chain.
 - b. The stainless steel tag shall have the tag number, design flow, and, when applicable, the differential pressure at design flow permanently engraved on its surface.
- L. Freezestats:
 - 1. Install freezestats for each hot water coil and provide protection for every square foot of coil surface area with one linear foot of element per square foot of coil.
 - 2. Upon detection of low temperature, the freezestats shall stop the associated supply fans and return the automatic dampers to their normal position. Provide manual reset.

3. Low limit freeze protection thermostats shall have 20' low point sensitive elements (not averaging type) installed to cover the entire coil face area. The elements shall be suspended at least 12" to 15" downstream of the preheater coil. These thermostats shall be 24 volt, two position, automatic reset type. Provide multiple freeze-stats to cover entire face of multi-coil banks. Every 20 square feet of coil requires one freeze-stat as minimum. Freezestats shall be hard wired.
- M. Firestats:
1. Provide manual reset, fixed temperature line voltage type with a bi-metal actuated switch.
 2. Switch shall have adequate rating for required load.
- N. Current Sensing Relay:
1. Provide solid-state, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
 2. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.
 3. Provide status device for all fans and pumps.
- O. Pressure Transmitter - Water Side:
1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated pressure range.
 2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.
 3. Transmitter shall be capable of operating from -20°F to +180°F and from 0 to 100%RH. Temperature effect shall be $\pm 1.0\%$ of span per 100°F.
 4. Transmitter shall be capable of withstanding pressures up to 1000 psig without damage to the instrument.
 5. Stability shall be $\pm 0.25\%$ of upper range limit for six months.
 6. Accuracy (including linearity, repeatability, and hysteresis) shall be $\pm 0.25\%$ of calibrated span.
 7. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.

8. Transmitter shall be furnished with flat mounting bracket for vertical mounting to a 2 inch pipe stand and drain/vent valve applicable for service conditions.

P. Differential Pressure Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated pressure range.
2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.
3. Transmitter shall be capable of operating from -20°F to +180°F and from 0 to 100%RH. Temperature effect shall be $\pm 1.0\%$ of span per 100°F.
4. Transmitter shall be capable of withstanding pressures ranging from 0 psig to 2000 psig on either side without damage to the instrument.
5. Stability shall be $\pm 0.25\%$ of upper range limit for six months.
6. Accuracy (including linearity, repeatability, and hysteresis) shall be $\pm 0.20\%$ of calibrated span. Linearity shall be $\pm 0.1\%$ of span; hysteresis shall be $\pm 0.05\%$ of span.
7. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.
8. Transmitter shall be furnished with flat mounting bracket for vertical mounting to a 2 inch pipe stand and drain/vent valve applicable for service conditions.

Q. Temperature Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated temperature range.
2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.
3. Transmitter shall be capable of operating from -13°F to +185°C.
4. Transmitter output shall fail upscale on loss of sensor input.
5. Stability shall be $\pm 0.20\%$ of calibrated span for six months.
6. Accuracy (including linearity, repeatability, and hysteresis) shall be $\pm 0.20\%$ of calibrated span.

7. Transmitter shall be furnished with mounting bracket for mounting to a 2 inch pipe stand. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.
8. Transmitter to be furnished complete with integrally mounted 100 Ohm Platinum RTD sensor.

R. Differential Temperature Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated temperature range.
2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.
3. Transmitter shall be capable of operating from -25°C to +85°C.
4. Transmitter output shall fail upscale on loss of sensor input.
5. Stability shall be $\pm 0.20\%$ of calibrated span for six months.
6. Accuracy (including linearity, repeatability, and hysteresis) shall be $\pm 0.10\%$ of calibrated span.
7. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.
8. Transmitter to be furnished complete with two (2) 100 Ohm Platinum RTD sensors wired in compensation loop configuration. Johnson Yokagawa or approved equal.
9. Transmitter shall be furnished with mounting bracket for mounting to a 2 inch pipe stand.
10. Natural Gas Flow Meters:
 - a. Meters shall be clamp-on type similar to Parametrics with 4-20 mA and pulse output.

2.14 DUCT-MOUNTED SMOKE DETECTOR

A. Product Description: NFPA 72, ionization type with the following features:

1. Auxiliary SPDT relay contact.
2. Key-operated normal-reset-test switch.
3. Duct sampling tubes extending width of duct.
4. Visual indication of detector actuation.
5. Duct-mounted housing.

- B. Furnish four-wire detector with separate power supply and signal circuits.

2.15 DIFFERENTIAL PRESSURE MONITOR

- A. Through-the-wall measurement for differential pressure.
- B. Digital Display:
 - 1. Differential pressure in inches or Pascal.
 - 2. State of pressure mode.
 - 3. High pressure alarm.
 - 4. Low pressure alarm.
 - 5. General failure.
 - 6. Status of door switch.
- C. Keyed switch to change mode from positive to negative to neutral.
- D. LED indicator for normal and alarm status.
- E. Audible horn indicating alarm condition with silencing button.
- F. Communications port.
- G. Two remote pressure transmitters.
- H. Auxiliary alarm relay output.
- I. Door switch contact.
- J. Calibration tool.

2.16 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Section 26 05 03.
- B. Motors: In accordance with Section 23 05 13.
- C. Disconnect Switch: Factory mount disconnect switch on equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify air handling units and ductwork installation is complete and air filters are in place before installing sensors in air streams.
- B. Verify location of thermostats and humidistats and other exposed control sensors with Drawings before installation.

- C. Verify building systems to be controlled are ready to operate.

3.02 INSTALLATION

- A. Install thermostats, humidistats, space temperature sensors and other exposed control sensors after locations are coordinated with other Work.
- B. Install thermostats, humidistats, space temperature sensors and other exposed control sensors 60 inches above floor. Align with light switches and humidistats. Install freeze protection thermostats using flanges and element holders.
- C. Install outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- D. Provide separable sockets for liquids and flanges for air bulb elements. Refer to Section 23 21 16.
- E. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Use one cabinet for each system. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face. Label with appropriate equipment or system designation.
- F. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- G. Install electrical wiring and conduit in accordance with Section 26 05 03 and Section 26 05 33.
- H. All wiring and tubing connections to control instruments, devices, etc., shall be made inside the cabinet, and numbered and color coded for identification. External ports shall be provided at the bottom or side of the control cabinet for the connection or entry of signal tubing, control wiring or power supply. Confirm BAS wiring color identification system with the Architect.

3.03 ELECTRICAL WIRING AND MATERIALS

- A. Install, connect and wire the items included under this Section and all other Sections of HVAC work. This work includes providing required conduit, wire, fittings, transformers and related wiring accessories. All conduit and wiring shall be installed in accordance with Division 26 Specifications.
- B. Provide conduit and wiring between thermostats, aquastats and unit heater motors, all control and alarm wiring for all control and alarm devices for all Sections of Specifications.

- C. Provide 120 volt, single phase, power to every B.M.S. DDC Controller panel, HVAC/Mechanical Equipment Controller, PC console, power supply, transformer, annunciator, modems, printers and to other devices as required.
- D. Provide status function conduit and wiring for equipment covered under this Section.
- E. Provide conduit and wiring between the B.M.S. panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit.
- F. Provide conduit and control wiring for devices specified in this Section.
- G. Provide conduit and signal wiring between motor starters/disconnect switches in motor control centers and high and/or low temperature relay contacts and remote relays in B.M.S. panels located in the vicinity of motor control centers.
- H. Provide conduit and wiring between the PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contractors, and B.M.S. panels, as shown on the drawings or as specified.
- I. All wiring to be compliant to IBC and Electrical Codes.
- J. Provide all conduit wiring for HVAC systems as required for a complete and operational system.
- K. Provide electrical wall box and conduits for all wall mounted devices. All conduits and boxes shall be concealed in walls.
- L. 120 Volt wiring shall be provided by Division 26 to local control panels. Division 23 Contractor shall be responsible for all 120V/24V transformers and all wiring to control devices for a complete and operational system.
- M. Reference Division 26 Specifications and drawings for conduit and wiring requirements.

3.04 FIELD QUALITY CONTROL

- A. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.
- B. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 230923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for control equipment and software in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 230900 - Instrumentation and Control for HVAC: Control system components.
 - 2. Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
 - 3. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections specified by this section.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI MC85.1 - Terminology for Automatic Control.
 - 2. ANSI/ASHRAE Standard 135 – BACNET – A Data Communication Protocol for Building Automation and Control Networks.

1.03 SYSTEM DESCRIPTION

- A. The Building Management System (BMS) shall be an extension of the existing campus-wide Johnson Controls Metasys System. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. The Building Management System (BMS) shall be connected to the owner's LAN via a CAT6A (or building standard) cable. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

- C. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Drawings and the associated interfacing work as referenced in the related documents.
- D. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- F. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- G. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management.
 - 7. Standard applications for terminal HVAC systems.
- H. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate the following:
 - 1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
 - 2. System schematics, including:
 - a. sequence of operations
 - 3. system riser diagrams
 - 4. Connected data points, including connected control unit and input device.
 - 5. System graphics showing monitored systems, data connected and calculated point addresses, and operator notations. Submit demonstration diskette containing graphics.
 - 6. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 7. Description and sequence of operation for operating, user, and application software.
 - 8. Use terminology in submittals conforming to ASME MC85.1.
 - 9. Coordinate submittals with information requested in Section 23 09 93.
 - 10. Submit BACNET system architecture drawings and BACNET compliant devices.
- B. Product Data: Submit data for each system component and software module.
- C. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.

2. Submit data specified in "Submittals" in final "Record Documents" form.
- B. Operation and Maintenance Data:
1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered system components and devices.
 2. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.06 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.
- B. BAS system provider will be same as the existing equipment provider. All integration will be done by factory certified technicians in the direct employment of the BAS system provider. Integration to existing BAS systems will be accomplished using factory licensed software purchased by the BAS provider.
- C. The manufacturer shall provide an on-site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the Building Automation System (BAS).
- D. The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project. A maintained service organization consisting of at least ten (10) competent servicemen for a period of not less than ten years and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.
- E. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- F. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category

PAZX; Standard ULC C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX, and be so listed at the time of bid. All floor level controllers shall comply, at a minimum, with UL Standard UL 916 category PAZX; Standard UL 864, categories UDTZ, and QVAX and be so listed at the time of Bid. The purpose of the regulation is to minimize electromagnetic interference between electronic products, which may diminish the performance of electrical products or disrupt essential communications.

- G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- H. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that shall assure consistency in the products delivered for this project.
- I. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network.
- J. Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 MAINTENANCE SERVICE

- A. Furnish service and maintenance of control systems for one (1) year from Date of Substantial Completion.
- B. Furnish complete service of controls systems, including callbacks. Make minimum of 4 complete normal inspections of approximately 8 hours

duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.

- C. Furnish four (4) complete inspections per year, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- D. Examine unit components bi-monthly. Clean, adjust, and lubricate equipment.
- E. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- F. Perform work without removing units from service during building normal occupied hours.
- G. Provide emergency call back service during all hours for this maintenance period.
- H. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- I. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.
- J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.10 EXTRA MATERIALS

- A. Furnish two printer ink cartridges and cartons of printer paper.

PART 2 - PRODUCTS

2.01 DIRECT DIGITAL CONTROLS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Johnson Controls Metasys System – Johnson Controls.
- B. Furnish materials in accordance with IBC.

2.02 OPERATOR WORKSTATION

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. Compaq
 - 2. Dell
 - 3. HP
- B. Furnish materials in accordance with IBC.
- C. Update existing Johnson Controls web-based GUI software to current factory revision.
- D. Coordinate final location of personal computer operator workstation with the Architect/Owner.
- E. Furnish each operator workstation consisting of the following:
 - 1. Personal Computer: IBM PC compatible with sufficient memory and hard drive storage to support graphics, reports, and communication requirements. Furnish with the following minimum configuration requirements:
 - a. Processor: I3, 3.2 GHz.
 - b. Hard Drive: 250 Gigabyte.
 - c. Memory: 2 Gigabyte DDR SDRAM.
 - d. Drive 1: 48x CD Burner, DVD combination.
 - e. Drive 2: 16x DVD-ROM, DVD combination.
 - f. Modem: Auto-dial telephone, 56,000 baud.
 - g. Ports: Required serial, parallel, network communications, USB, and cables for proper system operation.
 - h. Expansion Slots: 1 used for LAN card, 1 available.
 - i. LAN Card: EtherNet - RJ45 (100 base-T minimum).
 - j. Mouse: two-button optical type wireless.
 - k. Keyboard: 104 key.

2. Monitor: Minimum of 17 inch (432 mm) color, flat panel LCD display.
 3. Operating System: Windows XP.
 4. Printer: Furnish each operator workstation with laser printer and associated cables. Printer capable of minimum of 25 pages per minute (PPM) operation and compatible with standard parallel or USB communications or network capable.
 5. 400 VA UPS for workstation
- F. System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:
1. Access DDC network.
 2. Access or control same control unit.
 3. Access or modify same control unit database.
 4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
 5. Develop and edit database.
 6. Implement and tune DDC control.
 7. Develop graphics.
 8. Control facility.
- G. Location of PC and printer to be coordinated with Facilities Personnel.
1. Keyboard: 104 key.

2.03 Communication Gateways

- A. Provide software for full communication with the following systems specified herein and elsewhere in Division 23:
1. Boilers
 2. Leak detection panels
 3. Variable frequency (speed) drives
 4. GUI Server PC via internet and local IT network

2.04 CONTROL UNITS

- A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment located in NEMA 4 enclosures.
- B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.
- C. Control Units Functions:
 - 1. Monitor or control each input/output point.
 - 2. Completely independent with hardware clock/calendar and software to maintain control independently.
 - 3. Acquire, process, and transfer information to operator station or other control units on network.
 - 4. Accept, process, and execute commands from other control unit's or devices or operator stations.
 - 5. Access both data base and control functions simultaneously.
 - 6. Record, evaluate, and report changes of state or value occurring among associated points. Continue to perform associated control functions regardless of status of network.
 - 7. Perform in stand-alone mode:
 - a. Start/stop.
 - b. Duty cycling.
 - c. Automatic Temperature Control.
 - d. Demand control via a sliding window, predictive algorithm.
 - e. Event initiated control.
 - f. Calculated point.
 - g. Scanning and alarm processing.
 - h. Full direct digital control.
 - i. Trend logging.
 - j. Global communications.
 - k. Maintenance scheduling.

- D. Global Communications:
 - 1. Broadcast point data onto network, making information available to other system controls units.
 - 2. Transmit input/output points onto network for use by other control units and use data from other control units.
- E. Input/output Capability:
 - 1. Discrete/digital input (contact status).
 - 2. Discrete/digital output.
 - 3. Analog input.
 - 4. Analog output.
 - 5. Pulse input (5 pulses/second).
 - 6. Pulse output (0-655 seconds in duration with 0.01-second resolution).
- F. Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs. Furnish control units with minimum 30 percent spare capacity.
- G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
- H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard-wired LAN or 60 seconds over voice grade phone lines.
- I. Points in "Test" mode.
- J. DDC Controller:
 - 1. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.
 - 2. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
 - a. Control processes

- b. Energy management applications
 - c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - d. Historical/trend data for points specified
 - e. Maintenance support applications
 - f. Custom processes
 - g. Operator I/O
 - h. Dial-up communications
 - i. Manual override monitoring
- 3. Each DDC Controller shall support firmware upgrades without the need to replace hardware.
 - 4. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
 - 5. The operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - a. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
 - 6. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
 - 7. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V
 - b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact

- c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
 - d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
 - e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:
 - f. IEEE Standard 587-1980
 - g. UL 864 Supply Line Transients
 - h. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)
8. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.
- a. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 - b. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
9. Provide a separate DDC Controller for each AHU and/or other HVAC systems with steel enclosure. It is intended that each unique system be provided with its own point resident DDC Controller.
10. Provide a door-mounted graphically interface terminal to allow for direct-user access to the controller.
- a. The terminal shall provide the user with the following functionality as a minimum:
 - 1) View and set date and time
 - 2) Modify and override time-of-day schedules
 - 3) View points and alarms
 - 4) Monitor points
 - 5) Command and modify setpoints

- b. Provide color local user display minimum 8", with touch-screen interface.
- K. HVAC Mechanical Equipment Controllers:
 - 1. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.
 - 2. Each HVAC Mechanical Controller shall have sufficient memory to support its own operating system and databases, including:
 - a. Control processes
 - b. Energy management applications
 - c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - d. Historical/trend data for points specified
 - e. Maintenance support applications
 - f. Custom processes
 - g. Operator I/O
 - h. Dial-up communications
 - 3. Each HVAC Mechanical Equipment Controller shall support firmware upgrades without the need to replace hardware.
 - 4. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
 - 5. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
 - 6. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V

- b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact
 - c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
 - d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
 - e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:
 - f. IEEE Standard 587-1980
 - g. UL 864 Supply Line Transients
 - h. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)
- 7. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - a. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.
- 8. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
- L. Floor Level Network Application Specific Controllers (ASC)
 - 1. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs) through Floor Level LAN Device Networks.
 - 2. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASCs as a minimum:
 - a. Central System Controllers

- b. Terminal Equipment Controllers:
 - 1) Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.
- 3. Central System Controllers:
 - a. Provide for control of central HVAC systems and equipment including, but not limited to, the following:
 - 1) Air handling units
 - 2) Split system air conditioning units
 - 3) Existing boilers and hot water systems
 - b. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Provide a hand/off/automatic switch for each digital output for manual override capability. Switches shall be mounted either within the controller's key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides. In addition, each switch position shall be supervised in order to inform the system that automatic control has been overridden.
 - c. Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event communication with its DDC Controller is lost and to insure protection during power outages.
 - d. All programs shall be field-customized to meet the user's exact control strategy requirements. Central System controllers utilizing pre-packaged or canned programs shall not be acceptable. As an alternative, provide DDC Controllers for all central equipment in order to meet custom control strategy requirements.
 - e. Programming of central system controllers shall utilize the same language and code as used by DDC Controllers to maximize system flexibility and ease of use. Should the system controller utilize a different control language, provide an DDC Controller to meet the specified functionality.
 - f. Each controller shall have connection provisions for a portable operator's terminal. This tool shall allow the user to display, generate or modify all point databases and operating programs.

- g. Provide a door-mounted graphically interface terminal to allow for direct-user access to the controller.
 - 1) The terminal shall provide the user with the following functionality as a minimum:
 - a) View and set date and time
 - b) Modify and override time-of-day schedules
 - c) View points and alarms
 - d) Monitor points
 - e) Command and modify setpoints
 - 2) Provide color local user display minimum 8", with touch-screen interface
 - 4. Terminal Equipment Controllers:
 - a. Provide for control of each piece of equipment, including, but not limited to, the following:
 - 1) Terminal Devices
 - b. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, 0-10v, allowing for interface to a variety of modulating actuators.
 - c. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable.
- M. Additional features
- 1. The enclosure for all controllers shall be NEMA Type 4 which shall not be mounted directly to the device nor to the wall. The conduit entering points must be located at bottom of the enclosure.
 - 2. All controllers shall have manual overrides at the panels to manually adjust the setpoints without using computer or hand-held device.
 - 3. All controllers shall be able to function upon loss of network-wide signal/communications loop.
 - 4. Provide a door-mounted graphically interface terminal to allow for direct-user access to the controller.
 - a. The terminal shall provide the user with the following functionality as a minimum:

- 1) View and set date and time
 - 2) Modify and override time-of-day schedules
 - 3) View points and alarms
 - 4) Monitor points
 - 5) Command and modify setpoints
- b. Provide color local user display minimum 8", with touch-screen interface.

2.05 LOCAL AREA NETWORKS (LAN)

- A. The design of the BAS shall network operator workstations and stand-alone DDC Controllers (SAC). The network architecture shall consist of three levels, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs. All controllers shall be standalone DDC (SAC) controllers. Loss of network communications shall not stop/limit the control sequences specified herein.
- B. Provide communication between control units over local area network (LAN).
- C. LAN Capacity: Not less than 100 stations or nodes.
- D. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- E. LAN Data Speed: Minimum 56 Kb.
- F. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- G. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- H. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. In event transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.
- I. System shall have the capability to communicate with a BACnet network over Ethernet or BACnet/IP (according to Annex J). The intent is to use the system provided under this contract to communicate with control

systems provided by other vendors. In order to accomplish monitoring, commanding, and alarming as described in sections 2.10.B and 2.10.D, the following BACnet objects and services must be supported by the system.

1. The following BACnet standard objects, at a minimum, must be supported by the system:
 - a. Device
 - b. Analog Input
 - c. Analog Output
 - d. Digital (Binary) Input
 - e. Digital (Binary) Output
 - f. Notification Class
2. The following BACnet services must be supported for the system to act as a BACnet server as described below:

- a. For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initiate	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

- b. For the system to allow other BACnet devices to monitor its point values, the system must support the following:

BACnet Service	Initiate	Execute
Read Property		X

- c. For the system to allow other BACnet devices to command its point values, the system must support the following:

BACnet Service	Initiate	Execute
Write Property		X

- d. For the system to be able to send alarms to other BACnet devices and receive alarm acknowledgement, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element		X
Remove List Element		X
Acknowledge Alarm		X
Get Alarm Summary		X
Confirmed or Unconfirmed Event Notification	X	

- e. If the system will be sending messages to other BACnet devices via COV, it must support the following:

BACnet Service	Initiate	Execute
Subscribe COV		X
Confirmed or Unconfirmed COV Notification	X	

3. The following BACnet services must be supported for the system to act as a BACnet client as described below:

- a. For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initiate	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

- b. For the system to be able to monitor point values from other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Read Property	X	

- c. For the system to be able to command point values in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Write Property	X	

- d. For the system to be able to receive alarms from points in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element	X	
Remove List Element	X	
Acknowledge Alarm	X	
Get Alarm Summary	X	
Confirmed or Unconfirmed Event Notification		X

- e. If the system is capable of receiving BACnet point messages via COV, it must support the following:

BACnet Service	Initiate	Execute
Subscribe COV	X	
Confirmed or Unconfirmed COV Notification		X

J. Peer-to-Peer Building Level Network:

1. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.
2. The peer-to-peer network shall support a minimum of 100 DDC controllers and PC workstations
3. Each PC workstation shall support a minimum of 4 peer to peer networks hardwired or dial up.
4. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, air conditioning units, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.
5. Field panels must be capable of integration with open standards including Modbus, BACnet, and Lonworks as well as with third party devices via existing vendor protocols.

6. Telecommunication Capability:

- a. Auto-dial/auto-answer communications shall be provided to allow DDC Controllers to communicate with remote operator stations and/or remote terminals via telephone lines.
- b. Auto-dial DDC Controllers shall automatically place calls to workstations to report alarms or other significant events. The auto-dial program shall include provisions for handling busy signals, "no answers" and incomplete data transfers.
- c. Operators at dial-up workstations shall be able to perform all control functions, all report functions and all database generation and modification functions as described for workstations connected via the network. Routines to automatically answer calls from remote DDC or HVAC Mechanical Equipment Controllers shall be inherent in the Controller. The use of additional firmware or software is not acceptable. The fact that communications are taking place with remote DDC or HVAC & Mechanical Equipment Controllers over telephone lines shall be completely transparent to an operator.
- d. Multiple modems shall be supported by DDC or HVAC & Mechanical Equipment Controllers on the Peer-to-Peer Network to ensure continuous communication to workstation.

K. Management Level Network:

1. All PCs shall simultaneously direct connect to the Ethernet and Building Level Network without the use of an interposing device
2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet, OPC, and Apogee networks without the use of interposing devices.
3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
4. When appropriate, any controller residing on the peer to peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected

building level networks. Any PC shall be able to interrogate any controller on the building level network.

6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC and shall not stop/limit operation of the system.
7. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3
8. Access to the system database shall be available from any client workstation on the Management Level Network.

2.06 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:

1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.

15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
 16. Print selected control unit database.
- B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
- C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:
1. Add and delete points.
 2. Modify point parameters.
 3. Change, add, or delete English language descriptors.
 4. Add, modify, or delete alarm limits.
 5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
 6. Create custom relationship between points.
 7. Create or modify DDC loops and parameters.
 8. Create or modify override parameters.
 9. Add, modify, and delete applications programs.
 10. Add, delete, develop, or modify dynamic color graphic displays.
- D. Dynamic Color Graphic Displays:
1. Utilizes custom symbols or system supported library of symbols.
 2. Sixteen (16) colors.
 3. Sixty (60) outputs of real-time live dynamic data for each graphic.
 4. Dynamic graphic data.
 5. 1,000 separate graphic pages.
 6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:

1. Accept data from LAN as needed without scanning entire network for updated point data.
2. Interrogate LAN for updated point data when requested.
3. Allow operator command of devices.
4. Allow operator to place specific control units in or out of service.
5. Allow parameter editing of control units.
6. Store duplicate data base for every control unit and allow downloading while system is on line.
7. Control or modify specific programs.
8. Develop, store and modify dynamic color graphics.
9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:

1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
4. Display alarm reports on video. Display multiple alarms in order of occurrence.
5. Define time delay for equipment start-up or shutdown.
6. Allow unique routing of specific alarms.
7. Operator specifies when alarm requires acknowledgment.
8. Continue to indicate unacknowledged alarms after return to normal.
9. Alarm notification:
10. Print automatically.
11. Display indicating alarm condition.

12. Selectable audible alarm indication.
- G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.
 - H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.
 - I. Messages:
 1. Automatically display or print user-defined message subsequent to occurrence of selected events.
 2. Compose, change, or delete message.
 3. Display or log message at any time.
 4. Assign any message to event.
 - J. Reports:
 1. Manually requested with time and date.
 2. Long term data archiving to hard disk.
 3. Automatic directives to download to transportable media including floppy diskettes for storage.
 4. Data selection methods to include data base search and manipulation.
 5. Data extraction with mathematical manipulation.
 6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
 7. Generating reports either normally at operator direction, or automatically under workstation direction.
 8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
 9. Include capability for statistical data manipulation and extraction.
 10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

- K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
- L. Data Collection:
 - 1. Automatically collect and store in disk files.
 - 2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2-year period.
 - 3. Daily consumption for up to 30 meters over a 2 year period.
 - 4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
 - 5. Archiving of stored data for use with system supplied custom reports.
- M. Graphic Display: Support graphic development on work station with software features:
 - 1. Page linking.
 - 2. Generate, store, and retrieve library symbols.
 - 3. Single or double height characters.
 - 4. Sixty (60) dynamic points of data for each graphic page.
 - 5. Pixel level resolution.
 - 6. Animated graphics for discrete points.
 - 7. Analog bar graphs.
 - 8. Display real time value of each input or output line diagram fashion.
- N. Maintenance Management:
 - 1. Run time monitoring, for each point.
 - 2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
 - 3. Equipment safety targets.
 - 4. Display of maintenance material and estimated labor.
 - 5. Target point reset, for each point.

O. Advisories:

1. Summary containing status of points in locked out condition.
2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
3. Report of power failure detection, time and date.
4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

2.07 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Demand Limiting:

1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
3. Forecast demand (kW): Predicted by sliding window method.
4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
5. Demand Target: Minimum of 3 for each demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
7. Limits: Include control band (upper and lower limits).
8. Output advisory when loads are not available to satisfy required shed quantity, advise shed requirements [and requiring operator acknowledgment].

C. Duty Cycling:

1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.

2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by equal quantity off portion is reduced.
3. Set and modify following parameters for each individual load.
 - a. Minimum and maximum off time.
 - b. On/Off time in one-minute increments.
 - c. Time period from beginning of interval until cycling of load.
 - d. Manually override the DDC program and place a load in an On or Off state.
 - e. Cooling Target Temperature and Differential.
 - f. Heating Target Temperature and Differential.
 - g. Cycle off adjustment.
- D. Automatic Time Scheduling:
 1. Self-contained programs for automatic start/stop/scheduling of building loads.
 2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
 3. Special day's schedule supporting up to 30 unique date/duration combinations.
 4. Number of loads assigned to time program; with each load having individual time program.
 5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
 6. Furnish the following time schedule operations:
 - a. Start.
 - b. Optimized Start.
 - c. Stop.
 - d. Optimized Stop.
 - e. Cycle.
 - f. Optimized Cycle.

7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
 8. Create temporary schedules.
 9. Broadcast temporary "special day" date and duration.
- E. Start/Stop Time Optimization:
1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
 2. Adaptive and self-tuning, adjusting to changing conditions unattended.
 3. For each point under control, establish and modify:
 - a. Occupancy period.
 - b. Desired temperature at beginning of occupancy period.
 - c. Desired temperature at end of occupancy period.
- F. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.
1. Employ arithmetic, algebraic, Boolean, and special function operations.
 2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.
- H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.
1. Define time interval between each control action between 0 to 3600 seconds.
 2. Output may be analog value.
 3. Provide for "skip" logic.
 4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.

- I. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.
 - 1. Control loops: Defined using "modules" are analogous to standard control devices.
 - 2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.
 - 3. Firmware:
 - a. PID with analog or pulse-width modulation output.
 - b. Floating control with pulse-width modulated outputs.
 - c. Two-position control.
 - d. Primary and secondary reset schedule selector.
 - e. Hi/Low signal selector.
 - f. Single pole double-throw relay.
 - g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
 - 4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
 - 5. Display: Value or state of each of lines interconnecting DDC modules.
- J. Fine Tuning Direct Digital Control PID or floating loops:
 - 1. Display information:
 - a. Control loop being tuned.
 - b. Input (process) variable.
 - c. Output (control) variable.
 - d. Set-point of loop.
 - e. Proportional band.
 - f. Integral (reset) Interval.
 - g. Derivative (rate) Interval.

2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".
- K. Trend logging:
1. Each control unit capable of storing samples of control unit's data points.
 2. Update file continuously at operator assigned intervals.
 3. Automatically initiate upload requests and then stores data on hard disk.
 4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
 5. Co-ordinate sampling with specified on/off point- state.
 6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.08 HVAC CONTROL PROGRAMS

- A. General:
1. Support Inch-pounds and S.I. metric units of measurement.
 2. Identify each HVAC Control system.
- B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
 2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
 3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
 4. Use outside air temperature to determine early shut down with ventilation override.
 5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
 6. Operator commands:
 - a. Define term schedule.

- b. Add/delete fan status point.
 - c. Add/delete outside air temperature point.
 - d. Add/delete mass temperature point.
 - e. Define heating/cooling parameters.
 - f. Define mass sensor heating/cooling parameters.
 - g. Lock/unlock program.
 - h. Request optimal run-time control summary.
 - i. Request optimal run-time mass temperature summary.
 - j. Request HVAC point summary.
 - k. Request HVAC saving profile summary.
7. Control Summary:
- a. HVAC Control system begin/end status.
 - b. Optimal run time lock/unlock control status.
 - c. Heating/cooling mode status.
 - d. Optimal run time schedule.
 - e. Start/Stop times.
 - f. Selected mass temperature point ID.
 - g. Optimal run-time system normal start-times.
 - h. Occupancy and vacancy times.
 - i. Optimal run time system heating/cooling mode parameters.
8. Mass temperature summary:
- a. Mass temperature point type and ID.
 - b. Desired and current mass temperature values.
 - c. Calculated warm-up/cool-down time for each mass temperature.
 - d. Heating/cooling season limits.
 - e. Break point temperature for cooling mode analysis.

9. HVAC point summary:
 - a. Control system identifier and status.
 - b. Point ID and status.
 - c. Outside air temperature point ID and status.
 - d. Mass temperature point ID and status.
 - e. Calculated optimal start and stop times.
 - f. Period start.
- C. Supply Air Reset:
 1. Monitor heating and cooling loads in building spaces, terminal reheat systems.
 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.
 3. Operator commands:
 - a. Add/delete fan status point.
 - b. Lock/unlock program.
 - c. Request HVAC point summary.
 - d. Add/Delete discharge controller point.
 - e. Define discharge controller parameters.
 - f. Add/delete air flow rate.
 - g. Define space load and load parameters.
 - h. Request space load summary.
 4. Control summary:
 - a. HVAC control system status (begin/end).
 - b. Supply air reset system status.
 - c. Optimal run time system status.
 - d. Heating and cooling loop.

- e. High/low limits.
 - f. Deadband.
 - g. Response timer.
 - h. Reset times.
- 5. Space load summary:
 - a. HVAC system status.
 - b. Optimal run time status.
 - c. Heating/cooling loop status.
 - d. Space load point ID.
 - e. Current space load point value.
 - f. Control heat/cool limited.
 - g. Gain factor.
 - h. Calculated reset values.
 - i. Fan status point ID and status.
 - j. Control discharge temperature point ID and status.
 - k. Space load point ID and status.
 - l. Airflow rate point ID and status.
- D. Static Pressure Reset:
 - 1. Monitor static pressure in supply air system and corresponding VAV box position.
 - 2. Reduce static pressure setpoint and resultant fan speed to utilize minimum fan energy.
- E. Enthalpy Switchover:
 - 1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
 - 2. Operator commands:
 - a. Add/delete fan status point.
 - b. Add/delete outside air temperature point.

- c. Add/delete discharge controller point.
 - d. Define discharge controller parameters.
 - e. Add/delete return air temperature point.
 - f. Add/delete outside air dewpoint/humidity point.
 - g. Add/delete return air dewpoint/humidity point.
 - h. Add/delete damper switch.
 - i. Add/delete minimum outside air.
 - j. Add/delete atmospheric pressure.
 - k. Add/delete heating override switch.
 - l. Add/delete evaporative cooling switch.
 - m. Add/delete air flow rate.
 - n. Define enthalpy deadband.
 - o. Lock/unlock program.
 - p. Request control summary.
 - q. Request HVAC point summary.
3. Control summary:
- a. HVAC control system begin/end status.
 - b. Enthalpy switchover optimal system status.
 - c. Optimal return time system status.
 - d. Current outside air enthalpy.
 - e. Calculated mixed air enthalpy.
 - f. Calculated cooling coil enthalpy using outside air.
 - g. Calculated cooling coil enthalpy using mixed air.
 - h. Calculated enthalpy difference.
 - i. Enthalpy switchover deadband.
 - j. Status of damper mode switch.

2.09 PROGRAMMING APPLICATION FEATURES

A. Trend Point:

1. Sample up to 50 points, real or computed, with each point capable of collecting 10,000 samples at intervals specified in minutes, hours, days, or month.
2. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:

1. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.
2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
3. Output assigned alarm with "message requiring acknowledgment".
4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:

1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
2. Program times for each day of week, for each point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Allow for holidays, minimum of 366 consecutive holidays.
5. Operator commands:
 - a. System logs and summaries.
 - b. Start of stop point.
 - c. Lock or unlock control or alarm input.
 - d. Add, delete, or modify analog limits and differentials.

- e. Adjust point operation position.
 - f. Change point operational mode.
 - g. Open or close point.
 - h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
 - i. Begin or end point totals.
 - j. Modify total values and limits.
 - k. Access or secure point.
 - l. Begin or end HVAC or load control system.
 - m. Modify load parameter.
 - n. Modify demand limiting and duty cycle targets.
6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:

- 1. Permit events to occur, based on changing condition of one or more associated master points.
- 2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.
- 3. Operator commands:
 - a. Define single master/multiple master interlock process.
 - b. Define logic interlock process.
 - c. Lock/unlock program.
 - d. Enable/disable interlock process.
 - e. Execute terminate interlock process.
 - f. Request interlock type summary.

E. Interface to World Wide Web:

- 1. Contractor shall provide all programming and interfaces as required to display and access all system features, including

alarms, maintenance messages, graphics, etc. on the World Wide Web.

2. The central BAS console shall be arranged to monitor, control and supervise all system items specified in this section, remotely, via the World Wide Web, using secured network connections. Contractor shall be responsible for all software and hardware requirements, as required for a complete and operational system. Contractor shall be responsible for coordinating network interface requirements with the Facilities Personnel.
3. Coordinate Uniform Resource Locator (URL) address name with Owner and provide all fees associated with obtaining rights to URL. Contractor shall be responsible for coordinating and obtaining Internet Service Provider.

2.10 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Disconnect Switch: Factory-mount on equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify conditioned power supply is available to control units and to operator workstation.
- B. Verify field end devices, and wiring is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation.
- C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.
- D. Install conduit and electrical wiring in accordance with Section 26 05 03.
- E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Furnish service technician employed by system installer to instruct Owner's representative in operation of systems plant and equipment for a 3-day period.

3.04 TESTING AND ACCEPTANCE

- A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets which shall be submitted prior to acceptance testing. Commissioning work which requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required.
 - 1. Prior to system program commissioning, verify that each control panel has been installed according to plans, specifications and approved shop drawings. Test, calibrate and bring on line each control sensor and device. Commissioning to include, but not be limited to:
 - a. Sensor accuracy at 10, 50 and 90% of range.
 - b. Sensor range.
 - c. Verify analog limit and binary alarm reporting.
 - d. Point value reporting.
 - e. Binary alarm and switch settings.
 - f. Actuator ranges.
 - g. Fail safe operation on loss of control signal, electric power, network communications.
- B. After control devices have been commissioned (i.e. calibrated, tested and signed off), each BAS program shall be put on line and commissioned. The contractor shall, in the presence of the Facilities Personnel, demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracy's. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance shall be immediately rectified and retested.

- C. After all BAS programs have been commissioned, the contractor shall verify the overall system performance as specified. Tests shall include, but not be limited to:
1. Data communication, both normal and failure modes.
 2. Fully loaded system response time.
 3. Impact of component failures on system performance and system operation.
 4. Time/Date changes.
 5. End of month/ end of year operation.
 6. Season changeover.
 7. Global application programs and point sharing.
 8. System backup and reloading.
 9. System status displays.
 10. Diagnostic functions.
 11. Power failure routines.
 12. Battery backup.
 13. Testing of all electrical and HVAC systems with other division of work.
- D. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure shall take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracy's and the system performance does not degrade over time.
- E. Using the test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate all system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.
1. All test instruments shall be submitted for approval.
 - a. Test Instrument Accuracy:

Temperature:	1/4F or 1/2% full scale, whichever is less.
Pressure:	High Pressure (psi): 1/2 psi or 1/2% full scale, whichever is less.
Low Pressure: (in	1/2% of full scale

w.c.)

Humidity: 2% RH

Electrical: 1/4% full scale

- F. After the above tests are complete and the system is demonstrated to be functioning as specified, a thirty day performance test period shall begin. If the system performs as specified throughout the test period, requiring only routine maintenance, the system shall be accepted. If the system fails during the test, and cannot be fully corrected within eight hours, the Facilities Department may request that performance tests be repeated.

3.05 DEMONSTRATION AND TRAINING

- A. Furnish basic operator training for 16 persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 40 hours instructor time. Furnish training on site.
- B. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes the sequence of operation and points to be connected to DDC control system. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 230900 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.
 - 2. Section 230923 - Direct-Digital Control System for HVAC: For equipment, devices, system components, and software to implement sequences of operation.
 - 3. Section 260533 – Raceways and Boxes for Electrical Systems for Conduit and Box Requirements.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
 - 2. Submit flow diagrams for each control system, graphically depicting control logic.
 - 3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 - 4. Coordinate submittals with information requested in Section 23 09 00 and 23 09 23.

1.03 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 SEQUENCE OF OPERATION

Sequence of operation for each control scheme is described below. Follow drawings and schedules for applicable systems. Where sequence of operations is not described herein, follow description of intent shown on drawings and submit control diagram for approval before proceeding with the installation.

A. Existing Boiler Plant:

1. Boiler Plant Startup and Stop:

- a. The DDC shall automatically start and stop the existing boiler plant by a command signal to the boiler plant that will start, sequence and stop the boiler. Firing of boiler and modulation of boilers shall be initiated by Boiler Control Panel (supplied by Boiler Manufacturer).
- b. From terminals on the boiler, the DDC shall provide indication of their status (off-on) to the BMS.
- c. Provide interface to the boilers through communication interface.

2. Boiler Plant Alarm and Monitor:

- a. The DDC shall monitor the existing boiler plant status and alarm if the boiler is shut down by safety devices, through dry contacts.
- b. The DDC prints an alarm when the break-glass switch is activated and print a message.
- c. When the DDC System indexes the boiler plant to start, it shall also start the secondary HW distribution pump. When the boiler is required to shutdown, the pump shall stop.

3. Boiler Operation:

- a. The boiler plant consists of one (1) boiler. The boiler is provided with a constant flow primary boiler pump. One secondary pump with variable speed drive shall be provided.
- b. On a call for heat, the boiler shall be started along with the boiler primary pump. The secondary hot water distribution pump shall be activated and shall operate to maintain the

required end-of-run differential pressure. Boiler water temperature shall be reset based upon outside air temperature from the boiler control panel.

- c. Secondary pump shall vary its flow rate via its VSD to maintain the required end-of-run differential pressure.
- d. When boiler is required to be shutdown, the associated primary pump shall stop.

4. Scheduled Hot Water:

- a. Hot water for hydronic user equipment shall be scheduled with outside air temperature, in inverse proportion to schedule below:

OAT = 0°F	HWS = 180°
OAT = 60°F	HWS = 120°
- b. Schedule shall be adjustable from one degree change in OAT to one degree change in HWS, to one degree change in OAT to 0.5 degree change in HWS.
- c. The OAT sensor shall reset the scheduled HWS sensor.

B. Single Zone Variable Air Volume Air Handling Unit (AHU-1)

1. Safeties:

- a. Automatic Operation: When alarmed, smoke detector on the return will stop the supply air and (through software interlock) the return air fan. When smoke condition is cleared and detectors are reset, the system resumes normal operation.
- b. Freezestat Operation: The freezestat (low temperature) detectors one for each preheat coil, are located downstream of the coils and are set for activation at 35°F.
- c. Upon activation, the supply fan and (through software interlocked) the return air fan both shut down. To prevent nuisance fan shutdowns, there is a time delay of 0-30 seconds (adjustable) for the detector before activation occurs. Once the fans have been shut down, manual reset, through a push button located at the DDC Panel, is required to restart them.
- d. Static Pressure Operation: The supply fan shall shut down upon a high discharge pressure or low suction pressure condition and shall stop the associated return fan through software interlock. The return fan shall shut down upon a low suction pressure condition and shall stop the associated

supply fan through software interlock. Once the fans have been shut down, manual reset, through a push button located at the DDC Panel, is required to restart them.

2. Unit Off:

- a. Upon unit shutdown on schedule or a command from BAS, the fan motor will be de-energized, the air handling unit's outside air damper and spill air damper will close.
- b. Whenever the air handling system is off, the secondary boiler pump is under the control of outside air temperature. When the outside air temperature drops below 35°F, the pump shall be started. If the pump fails to start, an alarm shall be issued to BAS.
- c. The preheat coil control valves will remain under control of the preheat coil discharge temperature sensors, to maintain a setpoint of 39°F (adjustable) during cold weather.

3. System Start Up:

- a. The supply air fan of the air handling unit shall be started per operation schedule or on a command from BAS and enable the outdoor air, spill air and return air dampers. The return air fan will be started through software interlock. The supply and return air fans shall start with their respective variable speed drives at minimum flow position and remain at minimum flow for sixty seconds (adjustable). The outside air damper will open to minimum specified setting. The spill air damper will open as required to meet minimum outside air intake and remain in this position unless overridden by economizer control or by requirement for 100% outside air.
- b. During system start up in winter, the economizer cycle will be locked out for five minutes (adjustable) to prevent unstable operation of the outside air damper.

4. Unit On:

- a. Pressure Control:
 - 1) To maintain the floor under a positive pressure, the supply air fan's air flow is tracked by a volumetric tracking system, which maintains a constant air flow differential between the supply and return air fans. Air measuring devices in the supply air and return air fans will, through differential pressure transmitters, modulate the return fan's variable speed drive to maintain the differential air flow.

- 2) A flow measuring device in the outdoor air duct will modulate the spill air damper to ensure the minimum outdoor air intake.
- b. Unoccupied Mode:
 - 1) In the unoccupied mode, the Outdoor air damper shall be closed. Spill Air damper shall be closed and return air dampers shall be open.
- c. Occupied Mode:
 - 1) During minimum outside air mode (non-economizer), spill air damper shall be in its open position. Return air damper shall be open.
 - 2) The outside damper shall be open to its minimum position.
5. Single Zone VAV Operation:
 - a. When the space sensor is satisfied, the unit shall drop back to 75% of airflow. The return fan shall track this reduction. Upon a rise in temperature above setpoint, the unit shall slowly modulate up to 100% of flow.
6. Seasonal Mode:
 - a. There are two seasonal modes of operation: "Heating Season" and "Cooling Season". System operation is automatically indexed to "Cooling Season" when the outside air temperature (main outside temperature) is greater than 61°F, then the controls will be indexed to cooling. When the outdoor air temperature is between 55°F and 60°F, 100% outside air will be used for cooling; below 56°F, outside air temperature program indexes system to "Heating Season". These modes may also be manually commanded at the console keyboard. Below 56°F, the compressors in the associated condensing unit for the air handling units shall be de-energized.
 - b. The air handling unit system's air discharge temperature is maintained at a given setpoint for the heating and cooling season:
 - Heating Season – 95°F (adjustable)
 - Cooling Season – 55°F (adjustable)
7. Heating:
 - a. To maintain discharge air temperature setpoint in the "Heating Season", the discharge air temperature sensor will,

through a three mode (P + I + D), direct acting fan discharge temperature software controller, modulate in sequence, the automatic dampers for economizer control- maximum outside air damper, maximum and minimum spill air dampers and return air damper, and finally the preheat coil control valves in sequence as the weather becomes colder. This sequence is reversed as weather becomes warmer; when the outdoor weather temperature becomes warm enough for the "Cooling Season", the cooling coil valve will be modulated to maintain discharge air temperature setpoint.

- b. Low Limit Control for Preheat Coils: If the discharge air controller does not maintain a leaving air temperature from the preheat coils above 39°F (adjustable), the local preheat controllers will, through a three mode (P + I + D) direct acting temperature controller, override the discharge air controller and modulate valves to maintain the temperature of the air leaving the preheat coils at 39°F, adjustable. Anti-reset windup will be provided to prevent controller overshoot by suppressing integral control until the control point is within the controller's proportional band. There will be one low limit controller per each preheat coil:

8. Cooling:

- a. To maintain discharge air temperature in the cooling season, the discharge air temperature sensor will, through a three mode (P + I + D), direct acting temperature software controller, stage the compressors in the condensing unit to maintain the discharge temperature setpoint of 55°F (adjustable). Above 65°F the outside air damper will be open to its minimum position, the return air damper open and the spill air damper will be opened in its minimum position to ensure minimum outside air intake.

9. Airside Economizer – 100% Outside Air for Cooling:

- a. The economizer cycle, set for 100% outside air, will be operative whenever the outside air temperature is between 55°F and 60°F. (adj.). Below 55°F the air handler will be in heating mode. Above 61°F the air handler will be in cooling mode. For the economizer cycle at 100% outside air, the outside air damper will be opened to its maximum position, the return air damper will be closed and the spill air damper will stay open in its maximum position. The discharge air temperature sensor will, through a three-mode (P + I + D), direct acting fan discharge temperature software controller stage the compressors in the condensing unit to maintain

the setpoint. For outside temperature below 54°F, the controller shall modulate the outside air, spill air and return air dampers to maintain setpoint during economizer cycle in the heating mode.

10. Morning Warm-up and Cool Down:

- a. In the warm-up mode, the hot water control valve shall be indexed full open, the spill air damper and outdoor air damper shall be closed and the return air damper shall be open. In morning cool-down mode, the compressors in the condensing unit shall be energized, the spill air damper and outdoor air damper shall be closed and the return air damper shall be open.

11. Night Setback:

- a. When space temperature falls below 55°F, the AHU shall start with no outdoor air capability. The preheat coils shall open to maintain space temperature setpoint.

12. Night Purge:

- a. During unoccupied periods, when the outside air temperatures are between 50 degrees F and 75 degrees F (adj.) and the RH is below 65%, AHU-1 shall run in full airside economizer at low fan speed so as to "purge" the air from the space. The compressor and hot water control valves shall remain closed during this operation.

13. Space Dehumidification:

- a. When the space RH exceeds 65% (adj.) during occupied time periods, the compressors shall be energized to provide full cooling. If space temperature drops below setpoint, the unit supply fan speed shall be reduced to 50% capacity and the return fan shall track the supply fan. Compressors in the condensing unit shall be energized to drive the coil discharge air temperatures down. Unit shall go into normal operation when space goes back to 50% RH.

14. Indication:

- a. System Monitoring: The DDC system will monitor: temperature transmitters, mixed air temperature, preheat air temperature, supply air temperature, return air temperature, outside air temperature; Dx supply temperature; water return temperature, static pressure transmitter, supply and return air flow, outdoor air flow, fan status, air flow measuring stations,

Fire Alarm Status (shutdown and purge), Freezestat Status, Dirty Filter Alarm, High and Low Pressure Alarm.

15. Alarms:

The following alarms will be displayed at the DDC System Console:

	<i>ATC Item</i>	<i>Alarm Setpoint (adj.)</i>
1)	Freezestats	35°F
2)	Dirty Air Filters	1.25" w.g.
3)	Supply Air Fan Failure	1" w.g.
4)	Return Air Fan Failure	1" w.g.
5)	Winter Discharge Air	62°F; 52°F High/Low
6)	Preheat Coil	58°F; 50°F High/Low
7)	Static Pressure (varies per system)	1.5" w.g.
8)	Safety Shutdown	
9)	CFM Differential	
10)	VFD Fault Indication	
11)	Carbon Dioxide Level	1000 ppm
12)	Outdoor Air Flow Rate	<50% of minimum outdoor flow rate as indicated in Contract Schedule
13)	Supply Air Flow Rate	
14)	Return Air Flow Rate	

C. High Filter Differential Pressure

1. An alarm shall be generated at the BMS when the differential pressure at the filters is higher than the recommended value.

D. AC Units:

1. AC units shall run 24 x 7 days a week and shall be under the control of the AC unit controller.
2. Standby AC units shall start when space temperature rises 2 degrees above setpoint of active/primary AC unit.
3. Status of AC units shall be monitored at BMS.
4. Electric duct heater shall be energized to maintain space temperature.
5. General Alarm shall be monitored at BMS.
6. Interconnecting wiring between AC units and condensing units shall be by BMS contractor.

E. Typical Exhaust Fan Control:

1. General:

- a. When the exhaust fan is off, its associated spill air damper shall be closed. When the exhaust fan is on, its associated damper shall open.
- b. Start/stop programming of all such fans shall be programmable from the BMS.
- c. Specific Control of Exhaust Fans Shall be as Follows:
 - 1) Toilet Exhaust Fan (EF-1)
 - a) Toilet exhaust fan shall be operational in the occupied mode for AHU-1. A manual switch shall be provided for operation of fan in unoccupied mode.
 - 2) Trash / Recycling (EF-2)
 - a) Trash / recycling fan shall be operational in the occupied mode for AHU-1. A manual switch shall be provided for operation of fan in unoccupied mode.

F. Electric Unit Heaters:

1. A unit-mounted thermostat shall energize the unit heater fan and the heating element to maintain space temperature.

G. Electric Cabinet Unit Heater:

1. Unit/wall mounted thermostat shall cycle fan ON/OFF and energize heating element to maintain space temperature.

H. Electric Baseboard

1. Unit-mounted thermostat shall energize the heating element to maintain space temperature.

I. Night Set-Back Mode for all HVAC Systems:

1. A space thermostat shall cycle supply and return fan of each unit to maintain thermostat's setting whenever the AC system is not running but the space temperature falls below 67°F (adj.) (Winter)/73°F (adj.) (Summer). When running under this mode, the outside air dampers shall stay closed and preheat coils shall be active in heating mode.

J. Pumps:

1. All pumps shall have start/stop and status indication at the BMS.

- K. Emergency Shutdown Switches:
 - 1. Provide emergency break-glass shutdown switches to shut down boiler in mechanical rooms. Upon shut-down, an alarm shall annunciate at the ATC system.
- L. Variable Frequency Drives (VFD):
 - 1. VFD's shall have four distinct modes of operation:
 - a. OFF – VFD and motor are off.
 - b. HAND – VFD output is manually controlled via speed selector input on drive.
 - c. AUTO – VFD output is controlled by BMS.
 - d. BYPASS – Drive Electronics are bypassed and unit acts as an across-the-line-starter operating at 100% speed. This allows for maintenance of drive while motor is still operating.

END OF SECTION

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for hydronic piping specialties in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Thermometer supports.
5. Test plugs.
6. Flexible connectors.
7. Air vents.
8. Strainers.
9. Pump suction fittings.
10. Combination pump discharge valves.
11. Auto flow control valve.
12. Drain Valves

- B. Related Sections:

1. Section 232123 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

- B. ASTM International:
 - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
 - 2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- C. American Water Works Association:
 - 1. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
 - 2. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
 - 3. AWWA C702 - Cold-Water Meters - Compound Type.
 - 4. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
 - 5. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- D. Underwriters Laboratories Inc.:
 - 1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
 - 2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.03 SUBMITTALS

- A. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of actual locations of components and instrumentation, flow controls and flow meters.
- B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Related Sections:
 - 1. Appendix 1.3 Geotechnical Report: Environmental conditions affecting products on site
- B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of glycol fluid and glycol charging components for one (1) year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

- A. Furnish two (2) bottles of red gage oil for static pressure gages.

1.12 EXTRA MATERIALS

- A. Furnish two (2) pressure gages with pulsation damper dial thermometers.

PART 2 - PRODUCTS

2.01 PRESSURE GAGES

- A. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Cast aluminum.
 - 2. Bourdon Tube: Brass.
 - 3. Dial Size: 4-1/2 inch and 8-1/2 inch] diameter.
 - 4. Mid-Scale Accuracy: One percent.
 - 5. Scale: Both psi and kPa.

2.02 PRESSURE GAGE TAPS

- A. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- B. Ball Valve: Stainless Steel, 1/8 inch NPT for 250 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- D. Siphon: Steel, Schedule 40, 1/4 inch NPT angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Weksler
 2. Taylor
 3. Mueller
- B. Thermometer: ASTM E1, adjustable angle, red appearing liquid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
1. Size: 9 inch scale.
 2. Window: Clear Lexan.
 3. Stem: Brass, 3-1/2 inch long.
 4. Accuracy: ASTM E77 2 percent.
 5. Calibration: Both degrees F and degrees C.
- C. Scale ranges should be as follows:
1. Hot water - 30°F to 240°F

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions [and with cap and chain].
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

- A. 1/4 inch NPT or 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 1. Neoprene core for temperatures up to 200 degrees F.
 2. Nordel core for temperatures up to 350 degrees F.
 3. Viton core for temperatures up to 400 degrees F.
- B. Test Kit:
 1. Carrying case, internally padded and fitted containing:
 - a. Two 3-1/2 inch diameter pressure gages.
 - b. One gage adapters with 1/8 inch probes.
 - c. Two 1-1/2 inch dial thermometers.

2.06 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- B. Float Type:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- C. Where the hot and cold water system is trapped and air is liable to be pocketed, furnish and install a manual vent to properly relieve the system of air. The discharge from these vents shall be piped with copper tubing to the nearest slop sink, floor drain or to a location easily accessible from the floor.

2.07 AUTOMATIC FLOW CONTROL VALVES

- A. In hot water supply (inlet) pipe to each hot water coil for all air handling units and all AC units, provide an automatic flow control valve as specified below:
 - 1. Flow control valves shall be factory calibrated, direct acting, automatic pressure compensating type. Each valve shall limit flow rates to within ± 5 accuracy, regardless of system pressure fluctuations. Valve control mechanism shall consist of a tamper proof, brass or stainless steel cartridge assembly with open chambers and unobstructed flow passages. Cartridge assembly shall include a self-cleaning, spring-loaded moving cup guided at two separate points and shall utilize the full available differential pressure to actuate without hysteresis or binding. Differential pressure ranges shall be minimum 3 to 40 psig. Each valve to be provided with a metal tag, chain and stamped for system identification. Pressure taps and quick disconnect valves shall be provided with ferrous bodies. All hydronic system flow control valves shall be of one manufacturer. Flow control valves shall be Autoflow or Griswold and shall be of 250 psig design.
 - 2. Furnish a portable flow measuring apparatus, complete with carrying case, pressure gauge, 3-way valve, hoses and connections. Unit to be compatible with automatic flow control valves to indicate pressure differential to determine flow rate through the valve.

2.08 RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

- B. Provide one or more relief or safety valves for each heat exchanger and piping system. The capacity of the relief valve shall be such that the pressure rating of the lower pressure piping and equipment not be exceeded if the reducing valve sticks open.
- C. Pressure relief valves on piping and equipment unless otherwise specified shall be of the pop safety type. They shall have enclosed springs and side outlets. Valve discharge piping shall be run to the high roof of the main buildings.
- D. Relief valves 2" and smaller shall be bronze, screwed, semi-finished and valves 2-1/2" and larger shall be iron body, bronze mounted and flanged.

2.09 DRAIN VALVES

- A. Provide drain valves with hose bibb end at all low points of water systems. Drain valves shall be gate type. Minimum 3/4" drain size shall be used up to 4" pipe size. 2" drain size shall be used for pipes 5" size and over. Also provide a fill valve for each water system, with a back-flow preventer as described below. All drain and fill valves shall have caps or plugs as applicable.

2.10 WATER RELIEF VALVES

- A. Where required provide ASME water relief valve. Each valve shall be provided with manual lifting lever capable of opening the valve as desired. A discharge line shall be run to floor drain from each valve. No shutoff valve shall be placed between relief valve and system

PART 3 - EXECUTION

3.01 INSTALLATION - METERS

- A. Install heat consumption meters and liquid flow meters with shutoff valves on inlet and outlet in the following locations:
 - 1. Positive Displacement Meter Location:
 - a. Expansion tank make-up.
 - 2. Heat Consumption Meter Location:
 - a. Heating water system.
 - 3. Flow Meter Location:
 - a. Heating water system.

3.02 INSTALLATION - THERMOMETERS AND GAGES

- A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
 - 1. In inlet and outlet of water coil.
 - 2. In inlet and discharge side of each pump.
 - 3. At each expansion tank.
 - 4. Other locations as shown on the drawings.
- B. Install gage taps in piping
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Install at the following locations:
 - 1. In inlet and outlet water connections at each water coil bank in each air handling unit.
 - 2. In inlet and outlet of hot water boilers.
 - 3. Supply, return and mixed air duct of each air handling unit.
 - 4. In supply and return water connection to each heating coil provide a thermometer and pressure gauge.
 - 5. At other locations shown on drawings.
- F. Coil and conceal excess capillary on remote element instruments.
- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.03 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs adjacent to thermometers and thermometer sockets and pressure gage taps as indicated on Drawings.
- B. Where large air quantities accumulate, provide enlarged air collection standpipes.
- C. Install manual air vents at system high points.
- D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- E. Provide drain valves at all coils, pieces of equipment and at all low points in system. Pipe to local floor drain.
- F. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- G. Provide drain and hose connection with valve on strainer blow down connection.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide balancing valves on water outlet for the following terminal heating unit types: unit heaters.
- J. Provide relief valves on pressure tanks and expansion tanks.
- K. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for hydronic pumps in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. In-line circulators.
- B. Related Sections:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.04 SUBMITTALS

- A. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

- A. Furnish one set of mechanical seals for each pump.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR ALL PUMPS

- A. Pumps shall be selected to operate at or near their point of peak efficiency thus allowing for operation at capacity of approximately 25% beyond design capacity. In addition, the design impeller diameter shall not exceed 90% of the maximum impeller diameter available for that model.

- B. In order to insure stable operation and prevent any possibility of hunting, the pump curve shall be continuously rising from maximum capacity up to the shutoff head.
- C. All pump casings shall be hydrostatically tested at 1-1/2 times design working pressure. The Design Working pressure is sum of total dynamic head plus total system static water head. The pump manufacturer shall be responsible for his service department aligning in the field prior to start-up of all flexibility coupled units. Alignment shall be with dial indicator with accuracy of plus or minus .002 inches.
- D. Each pump shall be guaranteed to circulate not less than the specified quantity of water against the specified circulating head when operating continuously, without overheating the motor or bearings, or the like, and without producing noise, audible anywhere in the building, outside of the space in which the pumps are installed.
- E. Pumps and pump motors shall be selected for parallel operation where any system is shown or piped to operate with two or more pumps. Pump motor horsepower shall be selected to insure non-overloading condition. Pump motors shall meet requirements of Section 23 05 13.
- F. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Bell & Gossett.
 - 2. Taco.
 - 3. Paco.

2.02 IN-LINE CIRCULATORS

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- B. Casing: Cast iron, with flanged pump connections.
- C. Impeller: Cast bronze, keyed to shaft.
- D. Bearings: Two, oil lubricated bronze sleeves.
- E. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.
- F. Seal: Carbon rotating against stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- G. Drive: Flexible coupling.

1. Motors: In accordance with Section 23 05 13. 1750 rpm unless indicated otherwise. All motors shall be inverter duty rated.
 2. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- H. Electrical Characteristics and Components:
1. Motors: In accordance with Section 23 05 13. 1750 rpm unless specified otherwise. All motors shall be inverter duty rated.
 2. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve. In addition, the design impeller diameter shall not exceed 90% of the maximum impeller diameter available for that model.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.
- C. Install pumps on vibration isolators. Refer to Section 23 05 48.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized balancing valve, and shut-off valve on pump discharge.
- E. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals.
- H. Check, align, and certify alignment of base mounted pumps prior to start-up.

- I. Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.
- J. Lubricate pumps before start-up.
- K. Install Work in accordance with IBC.
- L. Pressure gauges shall be installed on the suction and discharge connection of each pump.
- M. Each unit shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to the pump for Using Agency's reference.
- N. All pump casings shall be hydrostatically tested at 1-1/2 times design working pressure. The pump manufacturer shall be responsible for his service department aligning in the field prior to start-up of all flexibly coupled units. Alignment shall be with dial indicator with accuracy of plus or minus .002 inches. The pump manufacturer must submit a written report certifying that the alignment work has been performed by his personnel and that the pumps are ready for operation.

3.02 FIELD QUALITY CONTROL

- A. Inspect for alignment of base mounted pumps.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: This section includes requirements for refrigerant piping in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.

B. Related Sections:

1. Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, and firestopping for placement by this section.
2. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
3. Section 230553 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.

4. Section 230700 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
5. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections specified by this section.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 1. ARI 495 - Refrigerant Liquid Receivers.
 2. ARI 710 - Liquid-Line Driers.
 3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
 4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
 5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B31.5 - Refrigeration Piping.
 4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. ASTM International:
 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

4. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 6. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
1. UL 429 - Electrically Operated Valves.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.5, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Provide receivers on systems with piping runs exceeding 50 feet.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant strainers.
 - c. Refrigerant pressure regulators.
 - d. Refrigerant pressure relief valves.
 - e. Refrigerant filter-driers.
 - f. Refrigerant solenoid valves.
 - g. Refrigerant expansion valves.
 - h. Electronic expansion valves.

- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of refrigerant leak test piping system pressure test.
- E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- G. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.
- B. Perform Work in accordance with applicable code for welding hanger and support attachments to building structure.
- C. Perform Work in accordance with IBC.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience, approved by manufacturer.
- C. Design piping system and hangers and supports under direct supervision of Architect/Engineer experienced in design of this Work and licensed in State of New Jersey. Layout and sizing of piping shall be approved by the manufacturer.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 MAINTENANCE MATERIALS

- A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

1.12 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size and valve type.
- B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Steel Pipe: ASTM A53/A53M, Grade B, Schedule 40, black for all refrigerant relief vent piping.
 - 1. Fittings: ASTM A234/A234M forged steel welding type.
 - 2. Joints: Welded.

2.02 UNIONS, FLANGES, AND COUPLINGS

- A. 2 inches and Smaller:
 - 1. Ferrous Piping: 450 psig malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches and Larger:
 - 1. Ferrous Piping: 450 psig forged steel, slip-on.
 - 2. Copper Piping: Bronze.
 - 3. Gaskets: 1/16 inch thick preformed neoprene.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.03 PIPE HANGERS AND SUPPORTS

- A. Reference Section 23 05 29 for support requirements.

2.04 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div. Model.
 - 3. Sporlan Valve Co. Model.
- B. Indicators:
 - 1. Port: Single, UL listed.
 - 2. Body: Copper or brass, flared or solder ends.
 - 3. Sight glass: Color-coded paper moisture indicator [with removable element cartridge] and plastic cap.
 - 4. Maximum working pressure: 500 psig.
 - 5. Maximum working temperature: 200 degrees F.

2.05 VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Diaphragm Packless Valves:
 - 1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
 - 2. Phosphor bronze and stainless steel diaphragms, rising stem and hand wheel.
 - 3. Stainless steel spring, nylon seats, disc with positive back seating.
 - 4. Maximum working pressure: 500 psig.
 - 5. Maximum working temperature: 275 degrees F.
- C. Packed Angle Valves:

1. Forged brass, solder or flared ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig.
4. Maximum working temperature: 275 degrees F.

D. Ball Valves:

1. Two-piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered or threaded ends.
2. Maximum working pressure: 500 psig.
3. Maximum working temperature: 325degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends.
2. Maximum working pressure: 500 psig.

F. Refrigerant Check Valves:

1. Manufacturers:
 - a. Alco Controls Div, Emerson Electric Co.
 - b. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - c. Sporlan Valve Co. Model.
2. Globe Type:
 - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 300 degrees F.
3. Straight Through Type:
 - a. Spring, neoprene seat.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 200 degrees F.

2.06 REFRIGERANT STRAINERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Straight Line or Angle Line Type:
 - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass.
 - 2. Maximum working pressure: 450 psig.
- C. Straight Line, Non-Cleanable Type:
 - 1. Steel shell, copper plated fittings, stainless steel wire screen.
 - 2. Maximum working pressure: 500 psig.

2.07 REFRIGERANT PRESSURE REGULATORS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.08 REFRIGERANT PRESSURE RELIEF VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.

- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 450 psig setting; selected to ASHRAE 15.

2.09 REFRIGERANT FILTER-DRIERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Replaceable Cartridge Angle Type:
 - 1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig.
- C. Permanent Straight Through Type:
 - 1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.

2.10 REFRIGERANT SOLENOID VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Valve: ARI 760, pilot operated, copper or brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.
- C. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.
- D. Electrical Characteristics: 120 volts.

2.11 REFRIGERANT EXPANSION VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, mechanical pressure limit (maximum operating pressure MOP feature), non-adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and oversized at part load.

2.12 ELECTRONIC EXPANSION VALVES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
 - 3. Sporlan Valve Co.
- B. Valve:
 - 1. Brass bodies with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
 - 2. Electrical Characteristics: 12 VA, 12 volts DC.
- C. Evaporation Control System:
 - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, pre-selection allowance for electrical defrost and hot gas bypass.
 - 2. Electrical Characteristics: 12 VA, 115 volts, single phase, 50/60 Hz.

- D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.13 REFRIGERANT RECEIVERS

- A. Internal Diameter 6 inch and Smaller: ARI 495, UL listed, steel, brazed; 450 psig maximum pressure rating, with taps for inlet, outlet, and pressure relief valve.
- B. Internal Diameter 6 inch and Larger: ARI 495, welded steel, tested and stamped in accordance with ASME Section VIII; 450 psig with taps for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.14 INSULATION

- A. Provide 1" closed cell insulation on all refrigerant piping unless otherwise noted.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.02 REFRIGERANT SIZING

- A. Submit manufacturer's computerized calculations in accordance with ASHRAE procedures to confirm pipe sizes.

3.03 INSTALLATION - INSERTS

- A. Reference Section 23 05 29 for support requirements.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Reference Section 23 05 29 for support requirements.

3.05 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- E. Install pipe identification in accordance with Section 23 05 53.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide access where valves and fittings are not exposed.
- H. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Insulate piping and equipment; refer to Section 23 07 00.
- N. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- P. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- R. Provide electrical connection to solenoid valves. Refer to Section 26 05 03.
- S. Fully charge completed system with refrigerant after testing.

- T. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- U. Install refrigerant piping in accordance with ASME B31.5.

3.06 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

- 1. Install line size liquid indicators in main liquid line downstream of condenser.
- 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
- 3. Install line size liquid indicators downstream of liquid solenoid valves.

B. Refrigerant Valves:

- 1. Install service valves on compressor suction and discharge.
- 2. Install gage taps at compressor inlet and outlet.
- 3. Install gage taps at hot gas bypass regulators, inlet and outlet.
- 4. Install check valves on compressor discharge.
- 5. Install check valves on condenser liquid lines on multiple condenser systems.
- 6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

- 1. Install line size strainer upstream of each automatic valve.
- 2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
- 3. On steel piping systems, install strainer in suction line.
- 4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

- 1. Install permanent filter-dryers in low temperature systems.

2. Install permanent filter-dryer in systems containing hermetic compressors.
 3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
 4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.
- F. Solenoid Valves:
1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Install in liquid line of single or multiple evaporator systems.
 3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.07 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test refrigeration system with dry nitrogen to 1.3 times working pressure. Perform final tests at 27 inches vacuum and working pressure using electronic leak detector.
- C. Repair leaks.
- D. Retest until no leaks are detected.

END OF SECTION

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for HVAC ducts and casings in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Duct Materials.
2. Flexible ducts.
3. Insulated flexible ducts.
4. Transverse duct connection system.
5. Casings.
6. Ductwork fabrication.
7. Duct cleaning.

- B. Related Sections:

1. Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
2. Section 233300 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.02 REFERENCES

- A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Air Duct Leakage Test Manual.
 2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- D. Underwriters Laboratories Inc.:
1. UL 181 - Factory-Made Air Ducts and Connectors.
- E. National Air Duct Cleaners Association:
1. NADCA Standards for duct cleaning.

1.03 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS

- A. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 3/8 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire rated and other walls.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
 - 9. Submit shop drawings indicating duct runs, material, extent of internal lining, fire dampers, volume dampers access doors and elevation of all ducts.
 - 10. Also submit a book of Shop Standards for Sheetmetal Fabrication, for approval, before starting layout or fabrication of any portion of ductwork.
- B. Product Data: Submit data for duct materials, duct liner and duct connectors
- C. Samples: Submit two (2) samples of typical shop fabricated duct fittings.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Related Sections:
 - 1. Appendix 1.3 Geotechnical Report: Environmental conditions affecting products on site
- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.
- B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- C. Stainless Steel Ducts: ASTM A167, Type 316.

- D. Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.
- E. Fasteners: Rivets, bolts, or sheet metal screws.
- F. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Clevaflex
 - 2. Flexmaster
- B. UL 181, Class 1, constructed with interior liner of round corrugated aluminum duct with exterior fiberglass insulation and vinyl film vapor barrier.
 - 1. Pressure Rating: 10 inches wg positive or negative.
 - 2. Maximum Velocity: 4000 fpm.
 - 3. Temperature Range: -20 degrees F to 210 degrees F.
 - 4. Thermal Resistance: 4.2 square feet-hour-degree F per BTU.
 - 5. Furnish each flexible duct section with integral clamping devices for connection to round or oval fittings.
 - 6. Join each flexible duct section to main trunk duct through sheet metal fittings. Construct fittings of galvanized steel and equip with factory installed volume damper having positive locking regulator. Provide fittings installed in lined ductwork with insulation guard.
 - 7. Flexible metal duct connections shall, unless noted otherwise, be equal in size to the unit inlet connections, or shall be provided with adapters to match flexible hose to the unit inlet.
 - 8. At points of connection between the flexible duct and unit, permacel EZ-4719 or Minnesota Mining sealing compound shall be placed on the metallic surface and the flexible ductwork clipped over. A stainless steel clamp shall be placed over the connections, similar to Ideal Type 52 worm gear drive.
 - 9. Flexible ducts shall not be used for supporting diffusers from overhead supply ducts.

10. Up to 3 ft. long flexible metal duct may be used between conventional air diffusers and low pressure, constant volume supply duct mains provided that a six-sided sheetmetal box is installed at the diffuser with dimensions 2" larger than the diffuser inlet collar size. For example: For a 10" neck diffuser, provide a sheetmetal box of 12" x 12" x 12" connecting one side to the diffuser and adjacent side to the flexible duct. Provide spin collar and damper for each diffuser take-off where required.

2.03 SINGLE WALL SPIRAL ROUND DUCTS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
1. McGill AirFlow Corporation.
 2. Semco Incorporated.
 3. Spiral Mfg. Co., Inc.
- B. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.
- C. Follow requirement in Section 23 05 48 "Noise and Vibration Controls for HVAC Piping and Equipment" for internal duct insulation (liner).
- D. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

- E. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.04 DOUBLE WALL SPIRAL INSULATED ROUND DUCTS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
1. McGill AirFlow Corporation
 2. Semco Incorporated
 3. Spiral Mfg. Co., Inc.
- B. Product Description: Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 1 inch thick glass fiber insulation, solid galvanized steel inner wall; fittings manufactured with solid inner wall.

- C. Construct round duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

- D. Construct round fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.05 TRANSVERSE DUCT CONNECTION SYSTEM

- A. Product Description: SMACNA "E" rated and SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.06 CASINGS/PLENUMS

- A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

- B. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection.
- C. Provide all metal housing, casings or plenums. Metal casings or plenums shall be constructed and jointed by external 1-1/2" standing seams of No. 16 USS gauge galvanized steel sheets, reinforced with 1-1/2" x 1-1/2" x 1/4" angles spaced not more than 3'-0" apart. Additional angles shall be provided wherever necessary to prevent vibration.
- D. Wherever metal bottoms are to be provided, they shall be constructed to form watertight pans not less than 6" deep, with brass drains with strainers and threaded outlets located in each compartment where required. The bottom of each compartment shall be pitched to the drain. Provide water seal in drain lines to carry lines to nearest indirect drain.
- E. Casing or plenums shall be provided with steel supports, of type approved by Architect to properly support the equipment and to maintain pitch to the drains. Where insulated, they shall be arranged with adequate means of attaching the insulation, including the bottom, if any.
- F. The Contractor shall provide heavy rigid plates with all required drilling and cutouts, heavy braced to reduce vibration, for the installation of thermometers, thermostats and other instruments.
- G. Longitudinal reinforcing angles shall be installed on the inside in accordance with the following schedule:

<u>Height of Side Walls or Width of Roof</u>	<u>No. Angles</u>	<u>Angle Spanning</u>	<u>Length of Casing</u>	<u>Diagonal Bracing Pairs of Braces</u>
Up to 6'	0	-	Any	None
Up to 8'	1	Middle	Any	None
8' to 12'	2	1/3 points	Any	None
Over 12'	Variable	4' Centers	3&4 Panels	1
			5&6 Panels	2
			7&8 Panels	3

Angle size shall be 1-1/2" x 1-1/2" x 1/8" to 12' casing length, and 1-1/2" x 1/2" x 3/16" over 12' casing length.

NOTE: Provide knee-bracing for top of casing wherever required.

- H. All joints shall be caulked with Minnesota Mining Formula EC 1057 or Alumastic to make them airtight.
- I. Casing or plenums shall be supported on galvanized steel legs. The bottom at the floor and at any other connection to masonry shall be riveted to 1-1/2" x 1-1/2" x 1/8" galvanized steel angles which shall be secured to masonry with expansion shields and caulked tight with cement.
- J. Provide angles above and below access doors and frames for access doors.
- K. Casings for generator radiator exhaust shall have 500°F rated gaskets.

2.07 RETURN/MIXED AIR DOUBLE WALL PLENUMS

A. General:

- 1. Double-wall (insulated) pressurized plenum equipment enclosures shall be provided for all mixed air, return air and supply air discharge plenums. All panels and components shall be prefabricated and supplied by a nationally recognized manufacturer with published standards of construction, assembly and technical performance. The manufacturer shall have produced a standardized prefabricated panel system for at least 10 years. Construction and performance of the installed system and components shall conform to all specifications listed in this document. The system and components shall not be susceptible to damage from extended exposure to airflow, pressure differentials, vibration, air temperature or humidity.

B. Joint Construction:

- 1. Panels shall be of "snap-lock" construction, such that adjacent panels are held together rigidly with an integral, continuous self-locking joint on both inside and outside panel surfaces. These joints shall not require screws, H-connectors, tape or any other type of additional fasteners or connectors.

C. Panel Construction:

- 1. All panels shall be 4 inches thick, with a solid galvanized steel exterior shell, and a perforated interior galvanized steel shell.
- 2. The outer and inner shells shall be tack or spot welded to perimeter and internal longitudinal steel channels and box-end internal closures, in such a manner and spacing that the panel assembly shall not fail at the maximum operating loads specified in the Structural Performance specifications given in this document.

3. The outer shell shall be constructed of galvanized steel with a minimum 20-gauge thickness.
4. The inner shall be constructed of galvanized steel with a minimum 22-gauge thickness.
5. Perforated materials shall be 3/32-inch-diameter round holes with staggered spacing, 3/16 inch on center. The perforated material shall have a 23 percent open area.
6. All perimeter and internal longitudinal steel channel members shall be constructed of ASTM Type A-446 structural quality galvanized steel with a minimum 18-gauge thickness of ASTM Type A-526 commercial-quality galvanized steel with a minimum 16-gauge thickness.
7. All steel panel surfaces, internal channels, and trim items shall be fabricated from zinc-coated steel with a hot-dipped galvanized coating (minimum G-90 coating class as determined by ASTM A-525) and shall meet all requirements of ASTM A-526 for commercial-quality galvanized carbon steel.
8. Each panel assembly shall be completely filled with acoustical/thermal insulating material that is non-combustible, inert, mildew-resistant and vermin-proof. Insulation shall not settle within the panel assembly. No insulating materials shall be used that have a flame spread greater than 25 or a smoke developed greater than 50.

D. Components and Installation:

1. All plenum base channels shall be installed on a level concrete curb, the dimensions of which shall be determined from plan-view shop drawings of the system provided by the system manufacturer. Spacing of base channel attachments shall be as outlined in the manufacturer's standard details of assembly.
2. All assembly trim items shall be constructed of hot-dipped galvanized steel (minimum 18-gauge thickness) and furnished in standard lengths to be field cut to the required dimensions. Spacing of sheet metal screws, application of duct sealant and positioning of trim shall be in accordance with the plenum manufacturer's published erection and installation details.
3. All mechanical joints and external trim items shall be sealed with a UL-Classified duct sealant in accordance with manufacturer's recommendations. In order to show that joints have been sealed properly, enough sealant shall be used so that excess sealant is extruded from all completed external joints.

4. For enclosures to be installed indoors, joints and trim shall be sealed with a solvent-based duct sealant that is a polymeric rubber formulated to withstand temperatures from -20 to +150°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with a flame spread of 15 and smoke developed of 20 when applied to 18-gauge galvanized steel and a flame spread of 10 and smoke developed of 0 when applied to organic reinforced cement board, both at a coverage of 31 square feet per gallon. Sealant shall exceed 750 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb).
5. For enclosures to be installed indoors and outdoors, joints and trim shall be sealed with a solvent-based duct sealant that is a neoprene-phenolic mastic formulated to withstand temperatures from 02- to +300°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 5 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 53 square feet per gallon. Sealant shall exceed 1,000 hours under ASTM-D572 test conditions (oxygen bomb) without becoming brittle under 500 hours in QUV accelerated-exterior-aging apparatus without degradation (under ASTM-C732 test conditions).
6. Personnel access doors shall be provided where specified on drawings and shall be 24 inches wide by 60 inches high unless otherwise indicated. All doors shall be the same nominal thickness as the prefabricated standard door panel in which they are mounted. All access door panels and doors shall be constructed with a solid inner and outer shell (minimum 20-gauge thickness). Each door shall be installed in the door panel at the factory and shall have a minimum of two ball-bearing hinges and two wedge-lever door latches. All levers shall be operable from the interior and exterior sides of the door panels. All doors shall be installed to open against the air pressure differential. Doors shall seat against neoprene gasket materials, installed around the entire perimeter of the door frame in such a manner that door operation shall provide direct compression with no sliding action between the door and gasket.
7. Doors shall be furnished with windows, which are composed of double-glazed layers of wire-reinforced safety-glass, separated by an air space, and sealed against acoustical and air leakage by interior and exterior rubber seals.

8. Openings for pipe and conduits shall be field cut to ensure proper positioning. All framing members, collars and bellmouth fittings shall be insulated, welded and sealed according to the plenum manufacturer's published installation details.

E. Structural Performance:

1. The entire plenum installation shall be designed by the plenum manufacturer to be self-supporting. Where roof spans and wall loadings require additional structural strength, it shall be provided by heavier panel skins, additional internal longitudinal reinforcing members or additional structural members and necessary supporting pipe columns. The installer shall furnish and install all structural members and pipe columns according to the drawings and published installation details provided by the plenum manufacturer.
2. The finished plenum installation shall be able to withstand a positive internal static pressure of 6 inches wg and a negative internal static pressure of 6 inches wg. Installations subjected to the effects of weather shall be able to withstand a wind loading of 100 pounds per square foot.
3. Under the conditions specified in the previous section, the assembled structure shall not exhibit any panel joint deflections in excess of $L/200$, where L is the unsupported span length of any panel section within the completed plenum.

F. Acoustical Performance:

1. The plenum manufacturer shall provide certified testing data obtained from an acoustical laboratory, listing sound absorption and transmission loss characteristics of the panel assembly. When requested by the engineer, the plenum manufacturer shall arrange to have a copy of all pertinent acoustical laboratory reports forwarded directly from the laboratory to the engineer.
2. When tested according to ANSI/ASTM C423-66 or a subsequent version of this standard, the panel assembly shall have minimum sound absorption coefficients, as shown in the following table, in the 1/3 octave band center frequencies. The coefficients used shall be those reported by the acoustical laboratory.

Sound Absorption Coefficients

1/3 Octave Band

Center Frequency (Hz)	125	250	500	1000	2000	4000	NEC
0.63	1.09	1.17	1.08	1.03	0.97	1.00	

3. When tested according to ANSI/ASTM E90-70 or a subsequent version of this standard, the panel assembly shall have minimum airborne sound transmission losses, as shown in the following table, in the combined full octave band center frequencies.

<u>Sound Transmission Losses</u>							
<u>Octave Band</u>							
Center Frequency (Hz)	125	250	500	1000	2000	4000	8000
	16	24	35	45	53	58	37

G. Thermal Performance:

1. Insulating materials used in all prefabricated panel assemblies shall have the following maximum thermal conductance at a mean temperature of 75°F: 0.06 Btu per hour per square foot per degree Fahrenheit.

2.08 ACCESS DOORS FOR CASING AND PLENUMS

- A. Access doors not less than 20" x 48" shall be provided in equipment casings and plenums. They shall consist of No. 16 USS gauge galvanized steel sheets mounted on angle frames with cross-bracing to prevent sagging or warping, and shall have sponge rubber gaskets.
- B. Door shall be installed on angle or channel frames, extended where required to finish flush with insulation. In insulated casings, the doors shall be of double construction, filled with insulation 1" thick. Door openings in casings shall have angle frames to provide a true and uniform seating surface for the gasketed doors.
- C. Each door shall be equipped with three (3) six screw "T" shaped extra heavy zinc plated hinges with brass pins as manufactured by Ferrum Co. No. 245 or approved equal. Provide three (3) cast zinc lever type fasteners. Ventlock No. 310 or approved equal. Inside release levers shall be provided for each door.

2.09 INSULATED PANELS

- A. Provide insulated panels for all spaces to be blanked off inside fan housings and for unused portions of louvers and where noted on the drawings.
- B. Inside and outside sheets of panels shall be constructed of alloy 25 hard aluminum sheet 20 B & S gauge. Insulation shall be 1-1/2" thick polyurethane.
- C. Sections over 24" long shall be internally braced with inside Z-bars.

- D. Panels shall be assembled and installed in such a manner as to be completely airtight and rigid.

2.10 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, and reinforcing for operating pressures indicated.
- B. Ductwork shall be continuous, shall be built with joints and seams presenting a smooth surface on the inside and neatly finished on the outside. All joints and seams for supply, exhaust, make-up and return air ductwork shall be sealed airtight with approved non-hardening resilient caulking compound. "Airtight" shall mean duct leakage not exceeding 5% of design air quantity. Should duct leakage exceed this limit, Contractor shall reseal as required and rebalance systems at no cost to Owner. ALL ductwork shall be sealed with high pressure duct sealant. Seal Class A, as defined by SMACNA, shall be provided for all ductwork.
- C. Ductwork is exposed to view and considered an architectural component of the project. External tapes are not allowed and sealants/welds shall be finished in a workmanlike manner. All welding burns shall be filed and scraped clean. Excess sealants and filler material shall be removed. Duct supports shall have a finished appearance.
- D. See Section 23 05 48 for Noise and Vibration Controls for HVAC Piping and Equipment.
- E. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible Round Duct Construction Standards. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- F. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- H. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- I. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

- J. All longitudinal joints shall be Pittsburgh lock with full sealant.
- K. Slip drive joints are not acceptable.

2.11 HANGERS AND SUPPORTS

- A. Where hanger straps are used they shall be 1" x 18 ga. minimum, galvanized steel.
- B. Rectangular duct risers shall be supported at each floor by angles or channels secured to the sides of the duct with welds, bolts, sheet metal screws or blind rivets.
- C. Ducts over 60 inches wide shall be suspended on a trapeze type hanger. The duct shall not be secured to the hanger.
- D. Hanger spacing shall vary between 4 ft. and 8 ft. depending on duct size and distance between construction joints, such that, 4 ft. sections shall be supported every 4 ft. Provide additional hanger supports where indicated on drawings.
- E. Provide inserts, fishplates and other methods recommended by SMACNA, and as approved, for supporting hanger straps and trapeze hangers. Do not use or submit power actuated fasteners, expansion nails or pins for supporting duct hangers.

2.12 DUCT SEALANTS

- A. Use the following sealants for joints and seams for vapor barrier application to all ductwork unless called for otherwise:
 - B-F #30-02 for sealing high and low pressure ductwork
 - 3M-425 for taping joints in vapor-proof barriers
 - B-F #30-35 as a vapor barrier cement on insulation
- B. Use equivalent sealants if any of the above cannot provide flame spread rating of 25 and smoke developed rating 50 or less.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. All seams and joints shall be sealed to meet SMACNA Seal Class A.

- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.
- D. Install duct hangers and supports in accordance with Section 23 05 29.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.
- G. Casings: Install floor-mounted casings on 4 inch high concrete curbs. Refer to Section 03 30 00. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- H. Coordinate with all affected trades to insure that no ceilings, equipment or other materials other than as specifically provided herein are supported from ductwork or the ductwork hanger system.
- I. Coordinate with others as necessary to insure that access doors have been provided in hung ceilings, shaft wall, or other construction, of ample size for proper operation and maintenance of the installation.
- J. While the drawings shall be adhered to as closely as possible, the right is reserved to vary the run and size of ducts during the progress of the work if required to meet structural conditions.
- K. Contractor shall install all ductwork in strict adherence to the ceiling height schedules indicated on the Architect's drawings. Contractor shall establish the necessary space requirements for each trade. The sheet metal ductwork shall, whether indicated or not, rise and/or drop and/or change in shape to clear any and all conduits, lighting fixtures, plumbing and heating mains to maintain the desired ceiling heights.
- L. Transition pieces from rectangular to round at fan discharge shall be 16 gauge all-welded construction. Provide suitable angle reinforcement. Branches off medium and high pressure duct mains shall have conical taps.
- M. Provide watertight stainless steel or copper counter flashings around all ducts passing through openings in exterior wall or through roof.
- N. Provide a fire damper and sheetmetal sleeve for each duct penetration through fire rated walls. Wherever ducts penetrate Mechanical Equipment Room walls, floor and ceiling slabs, the entire space between duct and wall sleeve or slab opening shall be tightly packed with

approved soundproof material. Each face of opening shall further be caulked airtight with approved non-hardening resilient caulking.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers to low pressure ducts with 3 feet maximum length of flexible duct held in place with strap or clamp.
- C. Connect air outlets and inlets to supply ducts with three-foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.04 DUCT PRESSURE TEST

- A. Pressure Testing of Ductwork
 - 1. Air pressure testing during erection shall include separate air leakage tests of plenum, the horizontal distribution system ductwork and, after all ductwork is installed and the central station apparatus is erected, leakage testing of the entire System. The testing shall apply to all ductwork design to have 3" WG or higher fan static pressure.
 - 2. Similarly, all ductwork intended to operate under negative pressure of 3" WG or more shall be tested at design negative pressure as described below.
 - 3. Tests shall be made prior to insulation of system being tested using suitable test equipment including test blower, "U" tube, orifice, tubing and cocks, arranged to indicate the amount of air leakage.
 - 4. The leakage tests of the ductwork shall be made with pressure in the system, maintained at approximately 6 inches, obtained by operation of the test blower.
 - 5. All joints shall be inspected and checked for audible leakage, repaired if necessary and retested. Duct leakage shall be limited to the following:

<u>Average Size of Run Diameter or Equivalent</u>	100 ft. Run	
	(A)	B)
12 inches or less	10	1"
20 inches or less	15	2"
30 inches or less	25	6"
40 inches or less	30	9"

Average Size of Run Diameter or Equivalent	100 ft. Run	
	(A)	(B)
50 inches or less	30	9"

- (A) Permissible loss in cfm.
- (B) Corresponding differential gauge reading (0.875 inch diameter orifice plate).

6. Contractor shall test ductwork using SMACNA leakage test methods to limit amount of leakage per sq. ft. of ductwork prescribed for Leakage Class 6 or 6" WG Duct Design.

3.05 CLEANING

A. Scope of Work:

1. Contractor shall provide all labor, materials, facilities, equipment and services to thoroughly clean HVAC system including all supply air and exhaust ductwork, associated air devices, turning vanes, dampers, reheat coils, etc. Contractor shall remove, store and re-install ceiling tiles as required for access to systems. Contractor shall provide and install duct access doors as required for proper access. Contractor shall repair or replace all damaged ceiling tiles, wall penetrations, ceiling penetrations, floor penetrations, insulation, control components or other damaged items to match existing.
2. Determine cleaning method to prevent damage to existing systems. Notify Engineer of proposed method and impact on system prior to start. Also notify Engineer of any system defects discovered during cleaning process.

- B. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.06 HVAC SYSTEM CLEANING

- A. The Contractor shall clean all HVAC duct and air handling systems prior to the balancing of all HVAC systems.

B. Scope of Work:

1. Contractor shall provide all labor, materials, facilities, equipment and services to thoroughly clean HVAC system including all supply, return, outside air and exhaust ductwork, associated air devices, turning vanes, dampers, reheat coils, etc. Also clean air handling unit including enclosures, coils, fan, condensate pan and replace

filters. Contractor shall remove, store and re-install ceiling tiles as required for access to systems. Contractor shall provide and install duct access doors as required for proper access. Contractor shall repair or replace all damaged ceiling tiles, wall penetrations, ceiling penetrations, floor penetrations, insulation, control components or other damaged items to match existing.

2. Determine cleaning method to prevent damage to existing systems. Notify Professional of proposed method and impact on system prior to start. Also notify Professional of any system defects discovered during cleaning process.

C. Quality Assurance:

1. Abide by the following standards:
 - a. Surface Debris Weight <10 mg/100cm²
2. All sheet metal work shall be performed by Contractor specializing in this type of work and approved by the Professional.
3. Submittals:
4. Prior to start of work, submit to the Professional shop drawings locating proposed duct penetrations and access doors for inaccessible ceilings.
5. Provide manufacturer's data sheets on all solvents, cleaners and disinfectants used on project.
6. Contractor shall submit 3 copies of final report to Professional for review and approval. Report shall contain:
 - a. Tabulation of vacuum tests taken before and after cleaning process.
 - b. Findings of tests performed on debris collected within ACS.
 - c. Before and after photographs of representative areas of ductwork cleaned as part of this project.

D. Procedure:

1. Coordinate shut down of mechanical systems with the Construction Manager prior to start of work.
2. Contractor is required to remove all debris from all inside surface areas of ductwork.
3. Debris Collection Method:
 - a. Collection system shall be portable, self-contained units capable of adequately collecting dirt and debris loosened

from ductwork in a high powered vacuum system containing three stages of filtration. Final stage shall be HEPA filter (99.97% @ 0.3 micron).

- b. Collection system shall be capable of producing minimum of 2500 cfm with 0.42" W.G. negative static pressure and 025" dwg. velocity pressure of ductwork to be cleaned. HEPA filter vacuum capable of 95 cfm at 88" wc shall be used.
4. Agitation Method:
- a. Agitation equipment shall be Collom Duct Cleaning System or approved equal. High power/volume vacuum alone is not an acceptable method of agitation.
 - b. Agitation equipment shall have minimum capacity of 70 cfm of compressed air at 110 psi supplied at air tool or nozzle to effectively dislodge built up debris. Air tool or nozzle shall come in contact with all interior surfaces of ductwork. Air tool or nozzle shall be capable of dispensing coatings or sanitizing solutions to cover entire interior surface areas of ductwork.
 - c. Where ductwork is large enough and able to support the weight of a worker, hand tools and HEPA vacuums may be used. Workers must follow OSHA confined space requirements (OSHA 29 CFR 1910.146) and collection equipment must be used during this process.
 - d. Other acceptable agitation equipment are hand-, air-powered or electric-powered brushes.
5. Provide air tight temporary enclosures of open ductwork effected by duct cleaning.
6. All responsible measures shall be taken to control any an all offensive odors and/or mist vapors generated during cleaning process.
7. Debris removed during cleaning process shall be collected and tagged as to its origin within the Air Conveyance System (ACS). Precautions must be taken to ensure that debris is not dispersed outside the ACS during cleaning process.
8. All lined ductwork shall be cleaned and refurbished as required. Apply coating or surface treatment to entire surface.
9. All coils, drain pans, fans, registers or grilles shall be cleaned using one or a combination of the following methods:

- a. High pressure air
 - b. ARMEX cleaning system
 - c. Steam cleaning
 - d. Power washing
 - e. Contact vacuuming
 - f. Using biodegradable industrial type concentrated detergent
 - g. Using concentrated disinfectant, fungicide, odor counteractant, EPA approved material such as Oxine
10. Interior surfaces of air handling unit shall be visibly clean. Internally lined ductwork shall be visibly clean.
 11. No cleaning method shall be used that could damage system components or negatively affect integrity of system.
 12. Coat fiberglass lining to deter further deterioration and breakdown. Method and type of coating to be approved by the Professional prior to implementation.
 13. Coils shall be steam cleaned and wire brushed. Coil drain pans shall be steam cleaned. Cleaning methods shall not cause appreciable damage to, displacement of, or erosion to coil surface and shall conform to coil manufacturer recommendations.
 14. All loose debris shall be removed from return air plenum and all exposed surfaces shall be mechanically vacuumed.
 15. Air devices shall be removed, washed, dried, sanitized and replaced unless device cannot be removed. In this case, air device shall be hand vacuumed. Avoid disturbing volume damper settings.
 16. A sanitizing agent shall be applied to all interior metal duct surfaces cleaned as part of this project.
 17. Contractor shall repair, reassemble all components of HVAC system damaged, disassembled or disconnected during the cleaning process.

3.07 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply	Galvanized Steel
Supply	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	3 inch wg regardless of velocity.
Return and Relief	3 inch wg
General Exhaust	3 inch wg

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: This section includes requirements for air duct accessories in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Back-draft dampers.
2. Combination fire-and-smoke dampers.
3. Duct access doors.
4. Dynamic fire dampers.
5. Smoke dampers.
6. Volume control dampers.
7. Remote cable control damper.
8. Flexible duct connections.
9. Duct test holes.
10. Dial thermometers.
11. Static pressure gages.

B. Related Sections:

1. Section 230900 - Instrumentation and Control for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
2. Section 230923 - Direct-Digital Control System for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
3. Section 233100 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

4. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:
 1. UL 555 - Standard for Safety for Fire Dampers.
 2. UL 555C - Standard for Safety for Ceiling Dampers.
 3. UL 555S - Standard for Safety for Smoke Dampers.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- B. Product Data: Submit data for shop fabricated assemblies and hardware used.
- C. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 1. Fire dampers including locations and ratings.
 2. Smoke dampers including locations and ratings.
 3. Flexible duct connections.
 4. Volume control dampers.

5. Cable control dampers.
6. Duct access doors.
7. Duct test holes.
- D. Product Data: For fire dampers, smoke dampers, and combination fire and smoke dampers, submit the following:
 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 2. Indicate materials, construction, dimensions, and installation details.
 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- E. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of access doors, test holes.
- B. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.05 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. Perform Work in accordance with IBC.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.
- B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- C. Storage: Store materials in a dry area indoor, protected from damage.
- D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.12 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR ALL ACCESSORIES

- A. All accessories shall have a pressure rating equivalent to the duct system that they are installed in.
- B. Material construction shall match system that accessories are installed in.

2.02 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Ruskin.
 - 2. Greenheck.
 - 3. Potteroff
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S.
- C. Fire Resistance: 1-1/2 hours.
- D. Leakage Rating: Class I, maximum of 8 cfm at 4 inches wg differential pressure.
- E. Damper Temperature Rating: 250 degrees F for non-smoke control systems and 350 degrees F for smoke control systems.
- F. Frame: 16 gage, galvanized steel.
- G. Blades:
 - 1. Style: Airfoil-shaped, single piece, double skin.
 - 2. Action: Opposed.
 - 3. Orientation: Horizontal.
 - 4. Material: Minimum 16 gage equivalent thickness, galvanized steel.
 - 5. Width: Maximum 6 inches.
- H. Bearings: Stainless steel pressed into frame.
- I. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.
- J. Linkage: Concealed in frame.
- K. Release Device: Close in controlled manner and allow damper to be automatically reset.
- L. Actuator:
 - 1. Type: Electric 120 volt, 60 hertz, two-position, fail close.
 - 2. Mounting: External.

3. Each combination fire smoke damper shall be equipped with a UL Classified "Fire Stat". "Fire Stat" shall permit damper modulation during normal conditions and shall mechanically and electrically lock damper in a closed position when a duct temperature exceeds 212°F. Damper can be opened via the Fire Alarm System. The damper operation and construction shall meet requirements of UL555S, latest edition.
 4. All wiring material required to interconnect the operator with detection and/or alarm or other systems shall be furnished by this Contractor.
 5. Provide end switches for status indicator.
 6. All control wiring shall be homerun, daisy chaining of devices is not acceptable.
- M. Fusible Link Release Temperature: 212 degrees F.
- N. Finish: Mill galvanized.
- O. Factory installed sleeve and mounting angles. Furnish silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

2.03 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Doors shall be constructed to meet pressure class of duct system that they are installed in.
- B. Fabrication: Rigid and close fitting of galvanized steel or stainless steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover, minimum 22 gage interior casing.
1. Less than 12 inches square, secure with sash locks.
 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 3. Up to 24 x 48 inches: Three hinges and two compression latches.
 4. Larger Sizes: Furnish additional hinge.
 5. Access doors located on the bottom of ducts shall have cam fasteners in lieu of hinges in order to avoid interference with ceiling channel supports.

6. Provide access doors upstream and downstream of reheat coils.
7. Provide access door for all dampers including volume dampers, fire dampers, smoke dampers, combination dampers and motorized dampers.
8. Access panels with sheet metal screw fasteners are not acceptable.

2.04 DYNAMIC FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555.
- B. Fire Resistance: 1-1/2 hours.
- C. Dynamic Closure Rating: Dampers classified for dynamic closure to 2000 fpm and 4 inches wg static pressure.
- D. Construction:
 1. Integral Sleeve Frame: Minimum 20 gage roll formed galvanized steel. Length: 12 inches.
 2. Blades:
 - a. Style: Curtain type.
 - b. Action: Spring or gravity closure upon fusible link release.
 - c. Material: Minimum 24 gage roll formed, galvanized steel.
 3. Closure Springs: Type 301 stainless steel, constant force type, if required.
- E. Fusible Link Release Temperature: 212 degrees F.
- F. Mounting: Vertical or horizontal as indicated on Drawings.
- G. Duct Transition Connection, Damper Style:
 1. B style - rectangular connection, blades out of air stream, high free area.
 2. G style - A style connection, grille mounting tabs at end of sleeve for grille.
- H. Finish: Mill galvanized.

2.05 SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555S.
- B. Fire Resistance: 1-1/2 hours.
- C. Leakage Rating: Class I, maximum of 8 cfm at 4 inches wg differential pressure.
- D. Damper Temperature Rating: 250 degrees F for non-smoke control systems and 350 degrees F for smoke control systems.
- E. Frame: 16 gage, galvanized steel.
- F. Blades:
 - 1. Style: Airfoil-shaped, single piece, double skin.
 - 2. Action: Opposed.
 - 3. Orientation: Horizontal.
 - 4. Material: Minimum 16 gage equivalent thickness, galvanized steel.
 - 5. Width: Maximum 6 inches.
- G. Bearings: Stainless steel pressed into frame.
- H. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.
- I. Linkage: Concealed in frame.
- J. Actuator:
 - 1. Type: Electric 120 volt, 60 hertz, two-position, fail close and Electric 24 volt, 60 hertz, two-position, fail close.
- K. Sleeve: Factory installed 20 gage sleeve, minimum 12 inches long.
- L. Finish: Mill galvanized.

2.06 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

- C. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.
- D. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.

2.07 REMOTE CABLE CONTROL VOLUME DAMPERS

- A. Provide cable control system for all volume dampers located above gypsum board and other inaccessible ceilings.
- B. Bowden cable control kit shall provide all required hardware that shall be mounted onto all rectangular and round volume dampers and provide all interlocking gears and cabling for ceiling mounted control. Coverplate shall be 7/8" diameter cold rolled steel cover with zinc plating for painting by General Contractor. Provide five (5) 12" wrenches for operation.

2.08 FLEXIBLE DUCT CONNECTIONS

- A. Provide a suitable flexible connection in both the intake and discharge sides of each fan and air handling unit, where they connect to ductwork.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Minimum 6 inches wide; maximum 10 inches wide.
 - 3. Metal: 3 inch wide and 24 gage galvanized steel.
- D. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs. per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.09 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

2.10 DIAL THERMOMETERS

- A. Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
 - 1. Size: 3 inch.
 - 2. Lens: Clear Lexan.
 - 3. Accuracy: 1 percent.
 - 4. Calibration: Degrees F.

2.11 STATIC PRESSURE GAGES

- A. Dial Gages: 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front calibration adjustment, 2 percent of full scale accuracy.
- B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment installation is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Install back-draft dampers where indicated on Drawings.

- C. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 - 1. Spaced every 50 feet of straight duct.
 - 2. Before and after each duct mounted filter.
 - 3. Before and after each duct mounted coil.
 - 4. Before and after each duct mounted fan.
 - 5. Before and after each automatic control damper.
 - 6. Before and after each fire damper, smoke damper, combination fire and smoke damper.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- E. Install temporary duct test holes where indicated on Drawings and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- F. Install fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
 - 1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
 - 2. Install dampers square and free from racking with blades running horizontally.
 - 3. Do not compress or stretch damper frame into duct or opening.
 - 4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
 - 5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.03 INSTALLATION - THERMOMETERS

- A. Install thermometers in air duct systems on flanges.

- B. Locate duct-mounted thermometers minimum 10 feet downstream of mixing-dampers, coils, or other devices causing air turbulence.
- C. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
- D. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- E. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- F. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.
- G. Install thermometers in the following locations:
 - 1. Each supply air zone.
 - 2. Outside air.
 - 3. Return air.
 - 4. Mixed air.

3.04 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers to Owner's representative.

3.05 STATIC PRESSURE AND FILTER GAGES:

- A. Install filter and static pressure gages in the following locations:
 - 1. Built up filter banks.
 - 2. Unitary filter sections.
 - 3. Supply fan discharge.

END OF SECTION

SECTION 233400 - HVAC FANS

PART 1 – GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for HVAC fans in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Mixed flow fans.
 - 2. Centrifugal square inline fans.
- B. Related Sections:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
 - 2. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for resilient mountings and snubbers for fans for placement by this section.
 - 3. Section 230700 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
 - 4. Section 230900 - Instrumentation and Control for HVAC: Product requirements for control components to interface with fans.
 - 5. Section 230923 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 6. Section 233100 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
 - 7. Section 233300 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 8. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution and product requirements for connecting equipment specified by this section.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. American Refrigeration Institute:
 - 1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. Underwriters Laboratories Inc.:
 - 1. UL 705 - Power Ventilators.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- B. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.

- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Submit motor data in accordance with 230513.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.
- E. Perform Work in accordance with IBC.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Furnish five (5) year manufacturer's warranty for fans.

1.11 EXTRA MATERIALS

- A. Furnish two (2) sets of belts for each fan.

PART 2 - PRODUCTS

2.01 MIXED FLOW FANS

- A. Manufactures:
 - 1. Loren Cook
 - 2. Greenheck
 - 3. Trane
- B. Supply, exhaust or return air fans shall be of the inline mixed flow type as indicated on Contract Drawings.
- C. The housing shall be constructed of welded heavy gauge steel to assure no air leakage. Housing shall have inlet and outlet collars for slip fit duct connections. The housing and bearing supports shall be constructed of structural steel members to prevent vibration and rigidly support the shaft and bearings. Welded steel vanes shall straighten the flow of air from the fan discharge and support bearings and drives.
- D. Units shall incorporate a universal mounting system that allows the fan to be mounted in either vertical or horizontal configurations and field rotation of the motor position in 90-degree increments. Bearing life shall not be reduced below specified level in different configurations. Units size 30 and larger shall allow for field rotation of motor positions. Units shall accommodate base mount or ceiling hung mounting without structural modifications to the fan.
- E. The wheel shall be of the mixed flow type. Wheels shall have a wheel cone, spherical back plate and single thickness cambered blades. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19. The wheel cone and fan inlet cone shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.
- F. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 25% over the maximum operating speed. Close tolerances shall be maintained where the shaft makes contact with the bearings.

- G. Bearings shall be heavy duty, grease lubricated, self-aligning ball or roller flange mounted bearings with extended lubrication lines. Bearings shall be selected for a minimum life (L-10) of 200,000 hours at maximum operating speed and horsepower.
- H. Each assembled fan shall be test run at the factory at the specified fan RPM and vibration signatures shall be taken on each bearing in three planes; horizontal, vertical and axial. The maximum allowable fan vibration shall be 0.15 in/sec. peak velocity, filter-in reading as measured at the fan RPM. This report shall be provided at no charge to the customer upon request.
- I. Inlet and outlet sound power levels shall be provided for each of the eight (8) octave bands at the point of operation.
- J. Fans shall be licensed to bear the AMCA Seal for sound and air performance.

2.02 CENTRIFUGAL SQUARE INLINE FANS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Loren Cook Company.
 - 2. Greenheck Corp.
 - 3. Twin Cities.
- B. Product Description: V-belt drive with galvanized steel housing lined with 1 inch acoustic glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collar, gravity backdraft damper in discharge, horizontal hanging brackets.
- C. Fan Wheel: Backward inclined centrifugal type, aluminum construction.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- E. Motor and Drive Mounting: Out of air stream.
- F. Motor: Open drip proof.
- G. Bearings: ABMA 9 life at 200,000 hours.
- H. Accessories:
 - 1. Belt guard.

2. Motor cover.
3. Inlet safety screen.
4. Outlet safety screen.
5. Flexible duct connector.
6. Filter box with throwaway type filter.
7. Flanged inlet and outlet.
8. Inlet and Outlet ductwork companion flange.
9. Disconnect Switch: NEMA 250 Type 1, heavy duty enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Secure wall fans with cadmium plated steel lag screws to structure.
- B. Install motorized dampers for wall exhaust fans.
- C. Install safety screen where inlet or outlet is exposed.
- D. Pipe scroll drains to nearest floor drain.
- E. Provide sheaves required for final air balance.
- F. Each fan shall be factory painted inside and out with high grade machinery grey enamel paint.
- G. Fans too large to pass through available doorways may be split in halves along center of shaft, with hubs, etc., arrange to bolt together when erected. Such bolts shall have double nuts and cotter pins to prevent same from loosening. Provide scroll drains in all fans.
- H. Fan wheel diameters shown are minimum diameter. Fan BHP indicated for each duty shall not be exceeded over its entire operating range.
- I. Exhaust fans exposed to outdoor weather shall have two coats of chlorinated rubber base paint applied in the factory.
- J. Insulated fans: Cleanout doors shall be raised type to finish flush with outside of insulation covering.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.03 CLEANING

- A. Vacuum clean coils and inside of fan cabinet.

3.04 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.05 PROTECTION OF FINISHED WORK

- A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for air outlet and inlets in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Diffusers.
 - 2. Registers
 - 3. Grilles.
- B. Related Sections:
 - 1. Section 233300 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 SUBMITTALS

- A. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, throw, and noise level.
- B. Samples: Submit one (1) of each required air outlet and inlet type.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Perform Work in accordance with IBC.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

PART 2 - PRODUCTS

2.01 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Type: Square stamped, multi-core or plaque panel construction diffuser to discharge air in 360 degree pattern with sector baffles where indicated.
- C. Frame: To match ceiling construction.
- D. Fabrication: Steel with baked enamel. Custom color selected by Architect.
- E. Accessories: Butterfly damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.02 CEILING PLENUM SLOT DIFFUSERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Furnish materials in accordance with IBC.
- C. Type: Continuous wide slot (width as indicated on drawings), slots wide (number of slots as indicated on drawings), with adjustable vanes for left, right or vertical discharge.
- D. Fabrication: Steel with factory finish. Custom color selected by Architect.
- E. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket mitered end border.
- F. Plenum: Integral, galvanized steel, insulated.

2.03 CEILING SUPPLY REGISTERS/GRILLES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Aluminum extrusions with factory finish. Custom color selected by Architect.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.04 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Furnish materials in accordance with IBC.
- C. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, along long face.
- D. Frame: 1-1/4 inch margin with concealed mounting.
- E. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory finish. Custom color selected by Architect.
- F. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.05 FIXED LINEAR SUPPLY AND RETURN BAR GRILLES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Type: Extruded aluminum with 1/4" bars on 1/2" centers with 15° deflection. Deflection bars shall be fixed and parallel to the long dimension.
- C. Frame: 1 inch margin. Provide end caps, mitered corners, and blank-offs for a continuous appearance.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.06 WALL SUPPLY REGISTERS/GRILLES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, along long face, double deflection.
- C. Frame: 1 inch margin with concealed mounting and gasket.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.07 LINEAR MODULAR SLOT

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. E. H Price Company
 - 2. Titus
 - 3. Anemostat Air Products
- B. Type: Extruded aluminum, continuous linear slot with extruded aluminum pattern controller.
- C. Frame: To match ceiling construction.
- D. Fabrication: Aluminum extrusions .062 inch thick with end-caps, mitered corner and blank-offs for a continuous appearance.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.08 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.
- B. Frame: 1-1/4 inch margin with concealed mounting.

- C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades finish. Custom color selected by Architect.
- D. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Verify ceiling and wall systems are ready for installation.

3.02 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black.
- D. Provide mounting frame/border to match ceiling construction for each type of outlet.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 234000 - HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for HVAC air cleaning devices in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Disposable, extended area panel filters.
 - 2. Extended surface high efficiency media filters.
 - 3. High efficiency particulate air (HEPA) filters.
 - 4. Filter frames and housings.
 - 5. Filter gages.
- B. Related Sections:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
 - 2. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for wiring products for placement by this section.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 850 - Commercial and Industrial Air Filter Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- C. Military Standardization Documents:
 - 1. MIL MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods.

D. Underwriters Laboratories Inc.:

1. UL 586 - High-Efficiency. Particulate, Air Filter Units.
2. UL 900 - Air Filter Units.

1.03 PERFORMANCE REQUIREMENTS

- A. Conform to ARI 850 Section 7.4.
- B. Dust Spot Efficiency: Plus or minus 5 percent.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
- B. Product Data: Submit data on filter media, filter performance data, dimensions, and electrical characteristics.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for operation, changing, and periodic cleaning.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 EXTRA MATERIALS

- A. Furnish one set of disposable panel filters.

PART 2 – PRODUCTS

2.01 DISPOSABLE, EXTENDED AREA PANEL FILTERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Camfil Farr
 - 2. Flanders
 - 3. AAF
- B. Media: UL 900 Class 1, pleated, fine, glass fiber laminated to synthetic backing; supported and bonded to welded wire grid by corrugated aluminum separators.
 - 1. Frame: Non-flammable for pre-filter, Galvanized steel for final filter.
 - 2. Nominal thickness: 2 inches for pre-filter, 12 inches for final filter.
 - 3. Flat: 2 inches disposable, extended area panel filters. (Camfil Farr Model # 30/30 UL Class 1)
 - 4. Extended Surface: 12 inch Filter box with holding frames and blank-off sheets, extended surface retained, high efficiency media filters with 80-85 percent dust spot efficiency. (Camfil Farr Model # Riga-Flo)
- C. Rating, ASHRAE 52.1:
 - 1. Dust spot efficiency: 25-30 percent for pre-filter, MERV 13 80-85 percent for final filter.
 - 2. Initial resistance at 500 fpm
 - 3. Recommended final resistance: FILTER FRAMES AND HOUSINGS
- D. General: Fabricate filter frames and supporting structures of 16 gage galvanized steel or extruded aluminum T-section construction with necessary gaskets between frames and walls. The track shall accommodate 2" pre-filter and 12" final filter.
- E. Standard Sizes: For interchange ability of filter media of other manufacturers; for panel filters, size for 24 x 24 inches filter media, minimum 2 inches thick and minimum 12" thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.

- F. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gage galvanized steel; access doors with continuous gaskets and positive locking devices on both sides; extruded aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.
- G. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
- H. Filter Gauges: 3-1/2 inch diameter diaphragm actuated dial in metal case, 2 inch diameter diaphragm actuated dial in metal case, with static pressure tips.
- I. Each filter section shall be designed and constructed to house the specific type of filter shown on the equipment schedule. A double-walled hinged access door of the type described above shall be provided on both sides of the section.
- J. Filter tracks in flat sections shall be of extruded aluminum for increased rigidity.
- K. Filter sections shall accept 2-inch and 12-inch filters. Sections shall include side access slide rails.

2.02 FILTER GAGES

- A. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case. Furnish vent valves, black figures on white background, front calibration adjustment, range 0-2.0 inch wg, 3 percent of full scale accuracy.
- B. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install filters with felt, rubber, or neoprene gaskets to prevent passage of unfiltered air around filters.
- B. Install filter gage static pressure tips upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- C. Install as specified filters in their respective systems as soon as air handling units are installed in place. Do not run any supply fan system, whether it be for testing, adjusting or balancing purposes, before the specified filters are installed in place. After completion of installation and prior to acceptance, replace all filters with new media and calibrate all filter gauges.

- D. Install filter gages on filter banks with separate static pressure taps upstream and downstream of filters.
- E. Replace all air filters immediately prior to occupancy.

END OF SECTION

SECTION 236313 – AIR-COOLED CONDENSING UNIT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for air cooled condensing units in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 230923 - Direct-Digital Control System For HVAC.
 - 2. Section 230503 - Pipes And Tubes For HVAC Piping And Equipment
 - 3. Section 232300 - Refrigerant Piping
 - 4. Section 230900 - Instrumentation And Control For HVAC
 - 5. Section 260519 - Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections to boilers specified in this section.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground installation. Unit shall consist of a hermetic scroll air-conditioning compressor(s) assembly, an air-cooled coil, propeller-type condenser fans, and a control box. Unit shall discharge supply air upward as shown on contract drawings. Unit shall be used in a refrigeration circuit matched with a packaged air-handling unit.

2.02 QUALITY ASSURANCE

- A. Unit shall be rated in accordance with AHRI Standard 360.
- B. Unit construction shall comply with ANSI/ASHRAE 15 safety code latest revision and comply with NEC.
- C. Unit shall be constructed in accordance with UL 1995 standard and shall carry the UL and UL, Canada label.
- D. Unit cabinet shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- E. Air-cooled condenser coils for hermetic scroll compressor units shall be leak tested at 150 psig, and pressure tested at 650 psig.

- F. Unit shall be manufactured in a facility registered to ISO 9001:2000 manufacturing quality standard.

2.03 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be shipped as single package only, and shall be stored and handled according to unit manufacturer's recommendations.

2.04 WARRANTY

- A. Unit shall be provided with 5-year compressor warranty and one (1) year for the entire unit.

PART 3 - PRODUCTS

3.01 EQUIPMENT

- A. General:
 - 1. Factory-assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge, and special features required prior to field start-up.
- B. Unit Cabinet:
 - 1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish.
 - 2. A heavy-gauge roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging.
- C. Condenser Fans:
 - 1. Condenser fans shall be direct driven, propeller type, discharging air vertically upward.
 - 2. Fan blades shall be balanced.
 - 3. Condenser fan discharge openings shall be equipped with PVC-coated steel wire safety guards.
 - 4. Condenser fan and motor shaft shall be corrosion resistant.
- D. Compressor:
 - 1. Compressor shall be of the hermetic scroll type.
 - 2. Compressor shall be mounted on rubber grommets.
 - 3. Compressors shall include overload protection.

4. Compressors shall be equipped with a crankcase heater.
 5. Compressor shall be equipped with internal high pressure and high temperature protection.
 6. The unit shall use two scroll compressors manifolded together.
- E. Condenser Coils:
1. Standard Aluminum fin - Copper Tube Coils:
 - a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
 - b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
 - c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.
- F. Refrigeration Components:
1. Refrigeration circuit components shall include liquid line service valve, suction line service valve, a full charge of compressor oil, and a partial holding charge of refrigerant.
- G. Controls and Safeties:
1. Minimum control functions shall include:
 - a. Control wire terminal blocks.
 - b. Compressor lockout on auto-reset safety until reset from thermostat.
 - c. Each unit shall utilize the Comfort Alertt Diagnostic Board that provides:
 - 1) System Pressure Trip fault code indication
 - 2) Short Cycling fault code indication
 - 3) Locked Rotor fault code indication
 - 4) Open Circuit fault code indication
 - 5) Reverse Phase 3 fault code indication
 - 6) Welded Contactor fault code indication

- 7) Low Voltage fault code indication
 - 8) Anti-short cycle protection
 - 9) Phase reversal protection
 2. Minimum safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:
 - a. High discharge pressure cutout.
 - b. Low pressure cutout.
- H. Operating Characteristics:
 1. The capacity of the condensing unit shall meet or exceed ratings listed on schedules.
 2. Standard unit shall be capable to operate up to 125_F and down to 40_F.
- I. Electrical Requirements:
 1. Nominal unit electrical characteristics shall be 208 v, 3-ph, 60 Hz.
 2. Unit electrical power shall be single-point connection.
 3. Unit control circuit shall contain a 24-v transformer for unit control.
- J. Special Features:
 1. Unit-Mounted, Non-Fused Disconnect Switch: Switch shall be factory-installed and internally mounted. NEC and UL-approved non-fused switch shall provide unit power shutoff. Switch shall be accessible from outside the unit and shall provide power off lockout capability. Non-fused disconnect switch cannot be used when unit MOCP electrical rating exceeds 80 amps.
 2. Convenience Outlet: Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle. Outlet shall include 15 amp GFI (ground fault interrupter) receptacle with independent fuse protection. Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer. Outlet shall be accessible from outside the unit.
 3. Thermostat Controls:
 - a. Commercial Electronic Thermostat shall have 7-day time clock, auto-changeover, multi-stage capability, and large LCD (liquid crystal display) temperature display.

4. Louvered hail Guard Package: Louvered hail guard package shall protect coils against damage from hail and other flying debris.

END OF SECTION

SECTION 237300 - INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes modular factory fabricated air-handling units and accessories in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 2. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
 - 3. Section 230700 - HVAC Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 230923 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 5. Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
 - 6. Section 230503 – Pipes and Tubes for HVAC Piping and Equipment: Product requirements for refrigerant and hot water piping connections to air handling units.
 - 7. Section 232116 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.
 - 8. Section 233300 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 9. Section 230900 – Instrumentation and Control of HVAC.
 - 10. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connections specified by this section.
 - 11. Section 230514 - Motor Controls: Variable frequency controllers.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. ARI 430 - Central-Station Air-Handling Units.
 - 3. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
 - 1. UL 900 - Air Filter Units.
 - 2. UL - Fire Resistance Directory.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
7. Furnish for approval:
 - a. Floor plan showing dimensions and details for installation, including total weight of unit and of each section for multiple section units.
 - b. Front and side views as required to completely describe accessories and show required dimensions.
 - c. Details of housing construction showing materials of construction, structural elements, methods of providing thermal breaks and door seals, equipment supports, housing insulation and piping, details of wall air sealing design, electrical and control penetration of housing and assembly instructions and requirements.
 - d. Submit complete shop Drawings on fans, coils, condensate drain system, filters, etc. contained within the unit including fan performance curves.
 - e. Submit design performance including motor horsepower, CFM, fan static, coil conditions and internal unit pressure drops.
 - f. Approval of Drawings does not relieve the supplier from his responsibility of furnishing the specified product under these Specifications.

- C. Samples: Submit two (2) of each type of replacement filter media with frame.
- D. Manufacturer's Installation Instructions: Submit.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum of 5 years documented experience.
- B. Units shall be manufactured in a facility registered to ISO 9001 manufacturing quality standard.
- C. Air-handling unit assembly shall have UL 1995 certification for safety, including use with electric heat.
- D. Products requiring electric connection shall be listed and classified by ETL and CSA as suitable for the purpose specified and indicated.
- E. Coil performance shall be certified in accordance with AHRI Standard 410, latest edition.
- F. Unit performance shall be rated in accordance with AHRI Standard 430 for Central Air Handling Units and subject to verification of rating accuracy by AHRI-sponsored, third party testing. Units shall meet NFPA 90A requirements.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE AND PROTECTION

- A. All outdoor units shall be completely shrink-wrapped from the factory for protection during shipment. Tarping of bare units is unacceptable.
- B. Inspect for transportation damage and store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.09 EXTRA MATERIALS

- A. Furnish one set of fan belts for each unit.
- B. Furnish one set of filters for each unit.

1.10 START-UP REQUIREMENTS

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, condensate properly trapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been test run under observation.

PART 2 – PRODUCTS

2.01 GENERAL DESCRIPTION

- A. Units shall ship in the number of sections necessary to meet project requirements and shall ship in as many splits as specified in selection software. Split options as follows:
 - 1. Shipped in sections — shipping split.
 - 2. Shipped assembled.
- B. Unit shall be factory-supplied, factory-assembled, indoor, central station air handler. The air-handling unit may consist of a fan with the following factory-installed components as indicated on the equipment schedule.

2.02 CASING

- A. Construction:
 - 1. Unit shall be constructed of a complete frame with easily removable panels. Removal of any panel shall not affect the structural integrity of the unit.
 - 2. All units shall be supplied with a perimeter, 14-gage or heavier, G-90 galvanized, high tensile steel base rail with a pocket to accommodate roof curb. Perimeter lifting lugs for overhead lifting shall be provided on each shipping section. Slinging units in place of lifting lugs shall not be acceptable.

3. Unit shall be thermally broken to minimize the conduction path from the inside of the casing to the outside.
4. Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, and shall have one of the following exterior finishes as specified:
 - a. Pre-painted with a baked enamel finish passing 500-hour salt spray test (ASTM B-117) for pre-painted steel and 125-hour marine level 1 cohesion test (ASTM G-85.A5) for pre-painted steel.
5. Roof shall be double-wall, pitched in four directions at a minimum roof slope of 1/4-in. per foot across the width of the unit. No penetrations shall be made in pressure sensitive panels. Roof shall incorporate a standing top seam. All seams in the roof shall be gasketed and capped to prevent water infiltration into the unit.
6. Casing panels (top, sides, and bottom) shall be one piece double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
7. Casing deflection shall not exceed a 1:200 ratio when subject to an internal pressure of ± 8 -in. wg. Casing leakage rate shall be less than 1% at ± 8 in. wg of nominal unit airflow or 50 cfm, whichever is greater. Leakage rate shall be tested and documented on a routine basis on random production units.
8. Side panels shall be easily removable for access to unit and shall seal against a full perimeter automotive style gasket to ensure a tight seal.
9. The panel retention system shall comply with UL 1995 which states all moving parts (for example, fan blades, blower wheels, pulleys, and belts) that, if accidentally contacted, could cause bodily injury, shall be guarded against accidental contact by an enclosure requiring tools for removal.
10. Base rail shall overhang the curb to facilitate water run-off and protection of the curb to base connection from water intrusion.
11. Accessibility options shall be as follows:
 - a. Hinged double-wall access door on either side with removable access panel(s) on the other side.
12. Depending on the options selected and the remaining available space inside each section, the following options may be available:

- a. Thermal pane reinforced glass viewports shall be factory-installed on the access panel(s) or door(s) of this section.
 - b. Marine lights shall be factory-installed with or without GCFI (ground fault circuit interrupter) convenience outlets.
13. Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used. Painted welds on unit exterior steel or galvanized steel are not acceptable.
14. All coil sections shall be solid double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
- B. Access Doors:
 1. Access doors shall be one piece double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
- C. Drain Pans:
 1. Drain pans shall be insulated stainless steel construction. The pan shall be sloped toward the drain connection. Drain pan shall have 1 1/2-in. MPT connection exiting through the hand side or opposite side of the casing as specified. Drain connection shall be insulated from the drain pan to the point at which it exits the casing. One drain outlet shall be supplied for each cooling coil section. Drain pan shall allow no standing water and comply with ASHRAE Standard 62.1-2010. Where 2 or more coils are stacked in a coil bank, intermediate drain pans shall be provided and the condensate shall be piped to the bottom drain pan. The bottom coil shall not serve as a drain path for the upper coil.
- D. Unit Support:
 1. Unit shall be supported from a 6" concrete pad.

2.03 FANS

- A. General:
 1. Forward-curved fans shall have one double-width double-inlet (DWDI) fan wheel and scroll. They shall be constructed of galvanized steel with baked enamel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class I or II). Completed fan assembly shall be dynamically

balanced in accordance with 1989 ARI Guideline G and ANSI S2.19-1986 at design operating speed using contract drive and motor if ordered.

2. Fan assembly vibration shall not exceed 0.248 in. per second when mounted on active isolators. Vibration shall be measured in both vertical and horizontal directions at the specified fan operating speed using specified motor. Accelerometers shall be mounted on the motor near the bearing locations.
3. All fan sled components shall provide corrosion protection to pass 100-hour salt spray test per ASTM B-117.
4. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected with a maximum operating speed 25% below the first critical.
5. Belt drive fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be premium efficiency, open drip-proof or totally enclosed fan cooled NEMA Design A or B with size and electrical characteristics as shown on the equipment schedule. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members. All three-phase motors shall have a $\pm 10\%$ voltage utilization range and a 1.15 minimum service factor. Motor shall be compliant with the Energy Independence and Security Act (EISA) of 2007 where applicable. Single-phase motors shall be available up to and including 5 hp.

B. Performance Ratings:

1. Fan performance shall be rated and certified in accordance with AHRI Standard 430.

C. Sound Ratings:

1. Manufacturer shall submit first through eighth octave sound power for fan discharge and casing radiated sound. Sound ratings shall be tested in accordance with AHRI 260.

D. Mounting:

1. Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a common base assembly. The base assembly is isolated from the outer casing with factory-installed isolators and vibration absorbent an discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable. Units shall use 2-in. deflection spring isolators.

E. Fan Accessories:

1. Forward curved fans:
 - a. Variable frequency drives with or without bypass.
 - b. Magnetic motor starters.
 - c. Motor disconnects.
 - d. Belt guards.
 - e. Inlet screen.

F. Flexible Connection:

1. The base assembly is isolated from the outer casing with factory-installed isolators and vibration absorbent fan discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable.

2.04 BEARINGS AND DRIVES

A. Bearings: Self-aligning, grease lubricated, anti-friction with lubrication fittings extended to drive side of fan section. All bearing life calculations shall be done in accordance with ABMA 9 for ball bearings and ABMA 11 for roller bearings.

1. Forward-curved fans: Cartridge type bearings for Class I fans. Heavy-duty pillow block type, self-aligning, regreasable ball or roller type bearings selected for a minimum average life (L50) of 200,000 hours or optionally for an (L50) of 500,000 hours.

B. Shafts:

1. Fan shafts shall be solid steel, turned, ground, polished and coated with a rust inhibitor.

C. V-Belt Drive:

1. Drive shall be designed for a minimum 1.2 service factor as standard with a 1.5 service factor option and/or a factory-supplied extra set of belts. Drives shall be fixed pitch with optional variable pitch for motors 15 hp and less. All drives shall be factory mounted, with sheaves aligned and belts properly tensioned.

2.05 COILS

A. All water and direct expansion (DX) refrigerant coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with AHRI Standard 410. All water and direct expansion

coils shall be tested at 450 psig air pressure. Direct expansion coils shall be designed and tested in accordance with ASHRAE/ANSI 15 Safety Code for Mechanical Refrigeration (latest edition). Factory-supplied 1/2-in. OD coils shall be covered under the standard product one-year limited warranty.

B. General Fabrication:

1. All water and refrigerant coils shall have minimum 1/2-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches.
2. Aluminum plate fin type with belled collars.
3. Aluminum-finned coils shall be supplied with die-formed casing and tube sheets of mill galvanized steel or stainless steel as specified.

C. Hydronic Heating Coils:

1. Headers shall be constructed of steel with steel MPT connections. Headers shall have drain and vent connections accessible from the exterior of the unit.
2. Configuration: Coils shall be drainable, with non-trapping circuits. Coils will be suitable for a design working pressure of 300 psig at 200 F.

D. Refrigerant Coils:

1. Headers shall be constructed of copper with brazed joints.
2. Standard circuiting selections include:
 - a. Single distributor arrangement.
3. Replaceable nozzle, brass refrigerant distributors and seamless copper distribution tubes are supplied to ensure uniform flow.
4. Submittals must include a DX coil and condensing unit cross plot to show that the coil and condensing unit capacity match at the rated design conditions.

2.06 FILTER SECTIONS

- A. Flat filter sections shall accept either 2-in. or 4-in. filters. Sections shall include side access slide rails.
- B. Magnehelic Gages:

1. Housing shall be constructed of a die cast aluminum case and bezel with acrylic cover. Exterior finish shall be coated gray to withstand 168 hr salt spray corrosion test.
2. Accuracy shall be $\pm 2\%$ of full scale throughout range at 70 F.
3. Pressure limits shall be -20 in. Hg to 15 psig.
4. Overpressure relief plugs shall open at approximately 25 psig.
5. Temperature limits shall be 20 to 140 F.
6. Diameter of dial face shall be 4 in.
7. Process connections shall be 1/8-in. female NPT duplicate high and low pressure taps — one pair side and one pair back.

2.07 DAMPERS

- A. Factory-supplied dampers shall be warranted to be free from defects in material and workmanship for a period of 12 months after being installed or placed in service, but in no instance shall the period of warranty be longer than 18 months from the date of the original shipment by the manufacturer.

2.08 ELECTRICAL ACCESSORIES

- A. Marine Lights and Convenience Outlets:
 1. Cast, non-ferrous metal, weatherproof, fixture.
 2. Gasketed, heat and shock resistant glass globe protects against moisture and debris.
 3. UL listed.
 4. 100 watt type 'A' lamp maximum capacity.
 5. Cast, non-ferrous metal, single gang, weatherproof, switch enclosure.
 6. With convenience outlet: Factory supplied and wired, SPST, toggle switch and 15 amp, 120 vac/60 Hz, NEMA 5-15 type, ground fault circuit interrupt (GFCI) receptacle, weatherproof, 'In-Use' type, lockable cover, UL listed.
 7. All factory wiring penetrating through the panel is protected in 'RIGID' type metal conduit.

- B. Disconnects: Factory-supplied disconnects shall be covered under a 1 year limited warranty from the manufacturer from the date of shipment.
1. 200-230 volt/3-phase fused and non-fused disconnects shall have the following characteristics:
 - a. Visible blades.
 - b. Quick-make, quick-break operating mechanism.
 - c. Cover padlock hasp and handle lock "OFF."
 - d. 240 vac maximum.
 - e. Factory supplied and installed class RK5 fuses (fused disconnects only).
 - f. Up to 100,000 rms symmetrical amperes SCCR, utilizing appropriately rated Class R fuses.
 - g. Horsepower rated for motor applications.
 - h. Tangential combination knockouts for field wiring.
 - i. Spring reinforced plated copper fuse clips.
 - j. NEMA type 3R enclosures.
 - k. Insulated, bondable solid neutral assemblies.
 - l. UL listed, File E2875.
 - m. Meet or exceed NEMA KS1-1990.
- C. Bypass for Variable Frequency Drives: Factory-supplied bypasses shall be covered under a 1 year limited warranty from the manufacturer from the date of shipment.
1. 200-230 v/3 Ph/60 Hz (1 to 7.5 Hp):
 - a. 4-position panel-mounted disconnect style switch with lockable handle (locks not provided), meets OSHA 1910.
 - b. Switch position indication (LINE/OFF/ DRIVE/TEST).
 - c. Adjustable motor overload with trip indication (LINE position).
 - d. Manual overload reset button.
 - e. Horsepower rated for motor applications.
 - f. Direct control (no contactors, relays, or holding coils).

- g. Complete isolation of inverter in LINE position.
 - h. NEMA 4 type metal enclosures.
 - i. Terminal strip provided for field power supply wiring.
 - j. Lug connection for field ground wire.
 - k. Gold flashed, auxiliary switch contact set (for switch position monitoring).
 - l. Factory mounted, wired to VFD and motor, and run tested (motor and VFD must be factory supplied and installed).
 - m. UL; UL, Canada; CE listed.
- D. Variable Frequency Drives:
- 1. Variable frequency drives shall comply with specification section 230514.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with ARI 430.
- B. External duct flexible connections between unit and inlet and discharge ductwork shall not be used.
- C. Install assembled units with vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48.
- D. Install floor mounted units on concrete housekeeping pads at least 4 inches high and 6 inches wider than unit.
- E. Provide fixed sheaves required for final air balance.
- F. Unit manufacturer shall provide factory trained service personnel that are employees of the manufacturer to supervise installation and start-up of the air handling units on the job site.
- G. Air handling units shall be mounted on Mason Industries Super W pads on top of continuous 8" high (minimum) structural channels. Intermittent 4" legs are not acceptable.
- H. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 00.

- I. Install condensate piping with trap and route from drain pan to nearest floor drain. Refer to Section 23 21 13.

3.02 INSTALLATION DX COIL

- A. Make connections to coils with unions or flanges.
- B. Connect refrigerant piping to leaving airside of coil (counter flow arrangement).
- C. Install Dx coils to allow draining and install drain connection at low points.
- D. Install valves and piping specialties in accordance with details as indicated on Drawings.

3.03 INSTALLATION HOT WATER HEATING COIL

- A. Make connections to coils with unions or flanges.
- B. Connect water supply to leaving airside of coil (counter flow arrangement).
- C. Locate water supply at bottom of supply header and return water connection at top.
- D. Install water coils to allow draining and install drain connection at low points.
- E. Install valves and piping specialties in accordance with details as indicated on Drawings.
- F. Install automatic air vents at high points complete with shutoff valve. Refer to Section 23 21 16.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.05 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.06 DEMONSTRATION

- A. Demonstrate unit operation and maintenance.
- B. Furnish services of manufacturer's technical representative for one (1) hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.07 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for split-system air conditioners in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Indoor fan coil unit.
 - 2. Outdoor condensing unit.
- B. Related Sections:
 - 1. Section 230548 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
 - 2. Section 230923 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 3. Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
 - 4. Section 232300 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.
 - 5. Section 233300 - Air Duct Accessories: Flexible connections.
 - 6. Section 230923 - Direct-Digital Control System for HVAC: Control systems remote from unit.
 - 7. Section 260519 - Low Voltage Electrical Power Conductors and Cables: Electrical connection to units.
 - 8. Section 260533 - Raceways and Boxes for Electrical Systems for Conduit and Box Requirements.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
 - 3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ASTM International:
 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- D. National Electrical Manufacturers Association:
 1. NEMA MG 1 - Motors and Generators.
- E. National Fire Protection Association:
 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Product Data: Submit data indicating:
 1. Cooling and heating capacities.
 2. Dimensions.
 3. Weights.
 4. Rough-in connections and connection requirements.
 5. Duct connections.
 6. Electrical requirements with electrical characteristics and connection requirements.
 7. Controls.
 8. Accessories.
- B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

- D. Manufacturer's Field Reports: Submit start-up report for each unit.
- E. Manufacturer computerized refrigerant tubing sizing calculations.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of controls installed remotely from units.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Performance Requirements: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240 and ARI 340/360.
- B. Cooling Capacity: Rate in accordance with ARI 210/240 and ARI 340/360.
- C. Sound Rating: Measure in accordance with ARI 270.
- D. Insulation and adhesives: Meet requirements of NFPA 90A.
- E. Perform Work in accordance with IBC.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

- C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.09 COORDINATION

- A. Coordinate installation of condensing units with concrete pad on grade.
- B. Coordinate installation of fan coil units with building structure.

1.10 WARRANTY

- A. Furnish five (5) year manufacturer's warranty for compressors.

1.11 MAINTENANCE SERVICE

- A. Furnish service and maintenance of equipment for one (1) year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

1.12 MAINTENANCE MATERIALS

- A. Furnish one set for each unit of fan belts and filters.

PART 2 - PRODUCTS

2.01 SPLIT SYSTEM AIR CONDITIONING UNITS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 - 1. Carrier Corp.
 - 2. Mitsubishi.
 - 3. York International
- B. Furnish materials in accordance with IBC.
- C. Product Description: Split system consisting of air handling unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, electric heating coil, air filters, controls, fan coil unit accessories, condensing unit accessories, and refrigeration specialties.

2.02 INDOOR FAN COIL UNIT

- A. System Description: Indoor, ceiling- mounted, direct- expansion fan coils are matched with cooling only or heat pump outdoor unit.
- B. Agency Listings: Unit shall be rated per AHRI Standards 210/240 and listed in the AHRI directory as a matched system.
- C. Delivery, Storage, And Handling: Units shall be stored and handled per unit manufacturer's recommendations.
- D. Warranty: Provide five (5) year manufacturer's warranty.
- E. Equipment
 - 1. General: Indoor, direct- expansion, ceiling- mounted fan coil. Unit shall be complete with cooling/heating coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing.
 - 2. Unit Cabinet: Unit cabinet shall be constructed of galvanized steel. Cabinet shall be fully insulated for improved thermal and acoustic performance.
 - 3. Fans: Fan shall be tangential direct- drive blower type with air intake at the rear or bottom of the unit and discharge at the front.
 - 4. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a factory installed condensate pump and drain connection for hose attachment to remove condensate.
 - 5. Motors: Motors shall be open drip- proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 4- speed.
 - 6. Controls: Controls shall consist of a microprocessor- based control system which shall control space temperature, determine optimum fan speed, and run self diagnostics. The temperature control range shall be from 62_F to 86_F in increments of 1_F, and have 46_F Heating Mode (Heating Setback). The wireless remote controller shall have the ability to act as the temperature sensing location for room comfort.
 - 7. The unit shall have the following functions as a minimum:
 - a. An automatic restart after power failure at the same operating conditions as at failure.

- b. A timer function to provide a minimum 24- hour timer cycle for system Auto Start/Stop.
 - c. Temperature- sensing controls shall sense return air temperature.
 - d. Indoor coil freeze protection.
 - e. Wireless infrared remote control to enter set points and operating conditions.
 - f. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - g. Fan- only operation to provide room air circulation when no cooling is required.
 - h. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
 - i. Fan speed control shall be user- selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
 - j. Automatic heating- to- cooling changeover in heat pump mode. Control shall include deadband to prevent rapid mode cycling between heating and cooling.
 - k. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.
- 8. Electrical Requirements: Indoor fan motor to operate on 208- 230V. Power is supplied from the outdoor unit.
 - 9. Operating Characteristics: The system shall have a minimum SEER (Seasonal Energy Efficiency Ratio) and HSPF at AHRI conditions, as listed on the specifications table.
 - 10. Refrigerant Lines: All units should have refrigerant lines that can be oriented to connect from the left, right or back of unit. Both refrigerant lines need to be insulated.

2.03 OUTDOOR CONDENSING UNIT

- A. System Description: Outdoor air- cooled split system compressor sections suitable for on- the- ground mounting. Units shall consist of a rotary compressor, an air- cooled coil, propeller- type draw- through outdoor fan, reversing valve (HP), accumulator (HP units), metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of heat pump system. Units shall be used in a refrigeration circuit matched to heat pump fan coil units.
- B. Agency Listings
 - 1. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.
 - 2. Units shall be evaluated in accordance with UL standard 1995. C. Units shall be listed in the CEC directory.
 - 3. Unit cabinet shall be capable of withstanding 500- hour salt spray test per Federal Test Standard No. 141 (method 6061).
 - 4. Air- cooled condenser coils shall be leak tested at 550 psig.
- C. Delivery, Storage, And Handling: Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.
- D. Warranty: Provide five (5) year manufacturer's warranty.
- E. Equipment
 - 1. A. General: Factory assembled, single piece, air- cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the compressor.
 - 2. Unit Cabinet:
 - a. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked- enamel finish on inside and outside.
 - b. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
 - c. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
 - 3. Fans:

- a. Outdoor fans shall be direct- drive propeller type, and shall discharge air horizontally. Fans shall draw air through the outdoor coil.
 - b. Outdoor fan motors shall be totally- enclosed, single phase motors with class B insulation and permanently-lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
 - c. Shaft shall have inherent corrosion resistance.
 - d. Fan blades shall be non-metallic and shall be statically and dynamically balanced.
 - e. Outdoor fan openings shall be equipped with PVC metal/mesh coated protection grille over fan.
4. Compressor:
 - a. Compressor shall be fully hermetic rotary type.
 - b. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over- temperature and over- current.
 - c. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
 - d. Compressor assembly shall be installed on rubber vibration isolators.
 - e. Compressors shall be single phase.
5. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
6. Refrigeration Components:
 - a. Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, reversing valve.
7. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

- a. Controls:
 - 1) A time delay control sequence is provided standard through the fan coil board.
 - 2) Automatic outdoor- fan motor protection.
 - b. Safeties:
 - 1) System diagnostics.
 - 2) Compressor motor current and temperature overload protection.
 - 3) Outdoor fan failure protection.
8. Electrical Requirements:
- a. Unit shall operate 208- 230v.
 - b. Unit electrical power shall be a single point connection.
 - c. Unit Control voltage to the indoor fan coil shall be 0- 15V DC.
 - d. All power and control wiring must be installed per NEC and all local electrical codes.
 - e. 5. Unit shall have high- and low- voltage terminal block connections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify equipment rail for condensing unit is ready for unit installation.

3.02 INSTALLATION - INDOOR UNIT

- A. Install condensate piping with trap and route from drain pan to condensate drainage system. Refer to Section 23 21 13.
- B. Install components furnished loose for field mounting.
- C. Install connection to electrical power wiring in accordance with Section 26 05 03.
- D. Install Work in accordance with IBC.
- E. Provide all power and low voltage wiring in EMT between indoor and outdoor unit as required for a complete and operational system.

3.03 INSTALLATION - CONDENSING UNIT

- A. Install condensing units on vibration isolators. Refer to Section 23 05 48.
- B. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties specified in Section 23 23 00.
- C. Evacuate refrigerant piping and install initial charge of refrigerant.
- D. Install electrical devices furnished loose for field mounting.
- E. Install control wiring between air handling unit, condensing unit, and field installed accessories.
- F. Install connection to electrical power wiring in accordance with Section 26 05 03.
- G. Install Work in accordance with IBC.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.05 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.06 DEMONSTRATION

- A. Demonstrate fan coil unit operation and maintenance.
- B. Demonstrate starting, maintenance, and operation of condensing unit including low ambient temperature operation.
- C. Furnish services of manufacturer's technical representative for one-hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.07 PROTECTION OF FINISHED WORK

- A. Do not operate air handling units until filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 238200 - CONVECTION AND RADIANT HEATING UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for convection heating and cooling units and accessories in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Electric duct heaters.
 - 2. Electric Cabinet unit heaters.
 - 3. Electric Unit heaters.
 - 4. Electric baseboard heaters.
- B. Related Sections:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
 - 2. Section 260519 – Low Voltage Electrical Power Conductors and Cables: Execution requirements for electric connection to units specified by this section.
 - 3. Section 260533 – Raceways and Boxes for Electrical Systems for Conduit and Box Requirements.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers.

- B. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.
- C. Samples: Submit one sample of each radiation cabinet detailed.
- D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to accessories.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC.
- B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept units on site in factory packing. Inspect for damage. Store under roof.

- B. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

- A. Furnish two (2) sets of filters.

PART 2 - PRODUCTS

2.01 ELECTRIC DUCT HEATERS

- A. Electric duct heaters shall be open coil type as manufactured by Marley. Voltage, kW, size, control and accessories shall be as shown. Units shall be U.L. listed for zero clearance and meet all applicable requirements of the latest National Electric Code and A.N.S.I. standards.
- B. Heating elements shall be high-grade nickel-chrome. Element temperature shall not exceed 400 F below the melting point of the element allowed when energized with design voltage in still, free air at 75 F ambient.
- C. Heater frames and control boxes shall be constructed of 20-gauge galvanized steel or heavier. Frames shall be hot dipped galvanized after fabrication if spot welds are used.
- D. Mounting assemblies for the element support insulators shall pass between the insulators permitting free expansion of the insulators under high temperature conditions without cracking or breaking.
- E. All necessary controls for recycling shall be provided in heaters of more than 48 amps.
- F. The following features and accessories shall be furnished as an integral part of each unit:
 - 1. Control via AV unit's controller for electric duct heater.
 - 2. Disconnecting magnetic contactors.
 - 3. Air pressure switch.
 - 4. SCR controller.
 - 5. Transformer Class-II
 - 6. Manual reset high limit.

7. Door-interlock disconnect switch (non-fused).
8. Insulated control panel.
9. Hinged lid.
10. Dust-tight panel.
11. One-year warranty.

2.02 ELECTRIC CABINET UNIT HEATERS

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:
 1. Markel
 2. QMark
 3. Trane
 4. Modine
- B. Assembly: UL listed and labeled assembly.
- C. Heating Elements: Heating elements shall be enclosed copper tube, aluminum finned elements of coiled nickel chrome resistance wire, centered in tubes and embedded in refractory material, and shall be of the capacity and arrangement as specified on drawing.
- D. Cabinet: Construction of 16 ga. steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet and inlet grilles.
- E. Finish: Factory applied baked enamel of custom color as selected by Architect on visible surfaces of enclosure or cabinet.
- F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- H. Control: Multiple speed switch, factory wired, located in cabinet. Thermostat/sensor shall be as indicated on drawings. Provide local disconnect switch.
- I. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

2.03 ELECTRIC UNIT HEATERS

- A. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.
- B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.
- C. Cabinet: 0.0478-inch thick steel with easily removed front panel with integral air outlet and inlet grilles.
- D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- E. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.
- F. Motor: Permanently lubricated, sleeve bearings for horizontal models; ball bearings for vertical models.
- G. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Furnish thermal overload. Provide integral disconnect switch and return air thermostat.
- H. Electrical Characteristics: Refer to Contract Drawing.

2.04 ELECTRIC BASEBOARD HEATERS

- A. All heaters shall be constructed of rolled formed steel and painted with a powder coat textured finish. Color shall be selected by the Architect.
- B. Baseboards shall be a maximum of 6" high and 2-1/2" deep.
- C. Baseboards shall be constructed with a full length wireway along the back of the heater.
- D. Baseboard shall be provided with 6" ground lead wire at both right and left junction boxes.
- E. Baseboard shall have aluminum element rod with aluminum chimney designed fin.
- F. An over-temperature thermal limit shall extend the entire length of the heated area to serve as a safety device in case of air flow blockage in front of heater.

2.05 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for radiant floor heating products showing dimensions, temperature capacities (both constant and intermittent), pressure ratings (both operating and burst), flow rates, material composition, and bend radius.
- B. Shop Drawings: Submit shop drawings Within thirty (30) days of bid date showing representative radiant floor tube spacings and manifold locations on a per-zone basis, appropriate construction details, and field connection details. Include information on all parts of the system being provided by the manufacturer.
- C. Control Sequence: Submit control manufacturer's sequence of operation for the radiant floor heating portions of this project. Provide a written sequence describing operation and logic, along with a schematic wiring diagram.
- D. Samples: Submit three (3) twelve-inch (12") samples of each type and size of ,/ radiant floor tubing being furnished,
- E. Maintenance Data: Submit maintenance instructions, including repair of damaged components and a spare parts list. Include product data and drawings in accordance with requirements in Division-1.

2.06 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's instructions for unloading radiant floor heating materials and components, and moving them to their final locations.
- B. Handle system components carefully to prevent damage breaking or scoring. Do not install damaged system components; refer to manufacturer's guidelines. Project architect to determine whether to repair or replace. Store radiant floor tubing and components to protect from physical damage, and construction debris.
- C. Tubing shall be capable of withstanding exposure to direct sunlight without degradation for a period of at least thirty (30) days prior to installation. Tubing shall be capable of being installed directly on conventional base rock or sand fill material. The tubing can be pulled through holes drilled in construction framing and can be stapled directly to the top of the subfloor, or attached to the underside of the subfloor with the use of aluminum plates or suspension clips. Tubing shall be capable of bending at minimum bend radius (see Part 3), at temperatures above 50°F, without detrimental effect. Additionally, the tubing can be kinked without detrimental effect and shall be capable being restored to its original condition after kinking with the use of applied heat or a physical repair.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. For recessed units, verify recess dimensions are correct size.
- B. Verify wall construction is ready for installation.
- C. Verify ductwork is ready for installation.
- D. Verify concealed blocking and supports are in place and connections are correctly located.

3.02 INSTALLATION

- A. Install air coils in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible. Refer to Section 23 31 00.
- B. Support air coil sections independent of piping on steel channel or double angle frames and secure to casings. Furnish frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Install with airtight seal between coil and duct or casing.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- E. Protection: Install finished cabinet units with protective covers during remainder of construction.
- F. Electric Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- G. Electric Cabinet Unit Heaters: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed units.
- H. All conduit and wiring shall be installed in accordance with Division 26 Specifications.

3.03 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION

SECTION 260500 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes general requirements for Electrical Work in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Documents:
 - 1. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.
 - 2. This Section governs all requirements as applicable to the Electrical work specified in other Sections of Division 26.
- C. Related Sections:
 - 1. Section 017300 "Execution" for Cutting and patching.
 - 2. Section 013300 "Submittal Procedures."
 - 3. Section 013100 "Project Management and Coordination" for coordination drawings.
 - 4. Section 017839 "Project Record Documents."
 - 5. Section 083113 "Access Doors and Frames."

1.02 DIVISION OF RESPONSIBILITY

- A. The requirements under Section 260500 are intended for the party or parties who have been duly awarded the applicable portion of work to be performed under the indexed sections of Division 26 also known as the Electrical Work.
- B. In addition to electrical work required under Division 26, the scope of electrical work specified under Division 26 shall include the provision of all required power wiring to the equipment specified under Divisions 21, 22, 23, 27 and 28. Provide power to all motors, electric heaters, light fixtures, heat tracing equipment, control panels, electrically actuated valves, dampers, and other devices, specified under the various sections of the Divisions indicated.

1.03 REFERENCE STANDARDS

A. Compliance with the following codes and standards shall be required as applicable:

1. AEIC Association of Edison Illuminating Companies
2. ANSI American National Standards Institute
3. ASTM American Society for Testing Materials
4. BSA Board of Standards and Appeals (BS&A, NYS)
5. CBM Certified Ballast Manufacturers.
6. DEMA Diesel Engine Manufacturer's Association
7. EPA United States Environmental Protection Agency
8. ETL Intertek/Electric Testing Laboratories
9. FM Factory Mutual
10. IBC International Building Code
11. ICEA Insulated Cable Engineers Association
12. IEEE Institute of Electrical and Electronics Engineers
13. IES Illumination Engineering Society of North America.
14. MEA Materials and Equipment Acceptance (NYS)
15. NEC National Electrical Code
16. NEMA National Electrical Manufacturers Association
17. NETA Inter-National Electric Testing Association
18. NFPA National Fire Protection Association
19. NFC National Fire Codes (NFPA).
20. OSHA Occupational Safety and Health Administration
21. UL Underwriters' Laboratories, Inc.

B. Conform to materials and equipment rating standards, listings or classifications of the above organizations as well as ratings, listings or classifications accepted under local codes and laws.

1.04 COVERING OF WORK

- A. No electrical equipment, raceways or other work of any kind shall be covered up or hidden from view before it has been examined by the Architect. Any unsatisfactory or imperfect work or materials that may be discovered shall be removed and corrected immediately after being rejected and other work and materials shall be provided which shall be satisfactory to the Architect.

1.05 PROTECTION

- A. Contractor shall protect the work and material of all trades from damage by his work or workmen, and shall replace all damaged material with new.

1.06 CONCRETE AND GROUTING

- A. Requirements for concrete and grouting are specified in other Sections.
 - 1. Concrete shall be 3,000 psi stone concrete with water reducing admixture, except where otherwise specified.
 - 2. Concrete shall have air entraining admixture where exposed to weather.
- B. Contractor shall make coordinated layouts showing concrete work required for housekeeping pads, roof curbs, thrust blocks, etc. which are cast in place.
- C. Concrete housekeeping pads: 4" minimum thickness, sized to cover the full area of each piece of equipment provided.
- D. Concrete bases: Dimension and height to suit the equipment.
- E. Outside the building all concrete work related to electrical equipment shall be provided by the Trade Contractor of Division 26, unless otherwise noted in the Contract Documents.

1.07 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

- A. All work shall be designed to operate, and shall operate, under all conditions of load, without any objectionable sound or vibration. Sound or vibration noticeable outside of the room in which installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Sound or vibration conditions considered objectionable and caused by failure to follow the Contract Documents or

manufacturer's installation instructions shall be corrected in an approved manner by the Contractor at his expense.

1.08 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instructions and Demonstration for Owner's Personnel:

1. After all equipment is functioning properly, each system is to be automatically operated for ten (10) working shifts, and not to be adjusted during this period, 80 hours in heating and 80 hours in cooling seasons, scheduled at the convenience of the Owner. Any adjustments shall void the test and start the time period all over again.
2. The hours of operation are to include the Owner's designated personnel in each shift, for each season.
3. During this period, instruct the Owner's personnel in the use, operation and maintenance of all equipment of each system. Teaching shall include a lecture-type instruction given in a non-machine room environment. During the lesson, normal operation of the system installed and operating shall be explained, along with troubleshooting procedures. This shall be followed by a field inspection and demonstration of equipment.
4. The above instruction is exclusive of that required of specified equipment manufacturers. If more stringent or longer instruction is indicated for specific equipment or systems, these shall supersede the above requirements.

B. Operating and Maintenance Data:

1. Provide manufacturer's catalogues, instructions, maintenance and repair information and parts lists for operating equipment and devices.
 - a. Include performance curves for fans and pumps, factory furnished wiring diagrams and control diagrams, and applicable flow diagrams.
2. Data for the equipment actually installed is to be submitted.
3. The data is to be carefully checked for accuracy by comparison with the installed equipment nameplates.
4. Provide a recommended list of spare parts for equipment and list of special, non-standard tools to service equipment.

5. Index and assemble the instructions in durable loose-leaf binders.
6. The completed binders are to be available at the time the equipment installation begins.

1.09 WARRANTY

- A. The following supplements the GENERAL CONDITIONS for Electrical Work:
 1. Non-durable, expendable items such as lamps are not subject to replacement after the date of acceptance.
 2. Warranty time limits for equipment exceeding those indicated in GENERAL CONDITIONS are specified in the applicable Sections of Division 26.
- B. In addition, follow all requirements of the General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Closeout procedures.

PART 2 - PRODUCTS

2.01 IDENTIFICATION

- A. Refer to Section 260553 for requirements.

2.02 PRIME PAINTING

- A. All conduit, outlet boxes, pull boxes, splice boxes, supports and miscellaneous electrical within all Mechanical and Electrical equipment rooms shall be prime painted as specified herein.
- B. All exposed conduits, boxes and supports, except factory finished equipment, shall be painted. All un-galvanized surfaces shall be painted with zinc chromate, or approved equal, and all galvanized surfaces shall be prime coated with a phosphate pretreatment coating, dry film thickness of 0.35 with a 0.50 mil. one coat Glid-Guard galvanized steel primer Y5229, or approved equal.
- C. Upon completion of the prime coat of all electrical equipment specified above, all conduit, boxes and equipment shall be painted with finish coating, as specified under Division 9.
- D. All damaged factory painted surfaces shall be repaired to match original surface. If, in opinion of Owner, such repairs are unsatisfactory, item in question shall be completely refinished or replaced with new.

2.03 CLEANING AND ADJUSTING

A. Notification:

1. Inform Owner and Architect's field representatives of all cleaning schedules one week prior to starting.
2. Notify Owner and Architect again, 48-hours prior to each event. If neither attends the procedures, notify in writing, the specific task performed 24-hours after each event.
3. Damage to the building and equipment resulting from tests shall be repaired at no additional cost to the Owner.
4. Tests claimed to have been performed without following above procedures shall be deemed as not performed.

B. Cleaning:

1. Clean out all debris and dirt from the interior of all switchboards, panelboards, transformers and switches. Blow out transformers with dry nitrogen; pressure shall not exceed 15 psi. Use Vacuum cleaner with bag and cartridge filters to remove dirt and debris from the interior of switchboards, panelboards and switches. After cleaning, the systems shall be tested by an independent organization, approved by Owner prior to testing.
2. Clean all materials and equipment; leave in condition ready to operate and ready to receive succeeding finishes where required.
3. Clean the operating equipment and systems to be dust free inside and out.

C. Permanent Equipment Operating During Construction:

1. Use only in same service as the permanent applications, provided that written approval is granted by Architect.
2. Expendable media, including lamps used for temporary operation and similar materials are to be replaced just prior to acceptance.

D. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

E. Tools:

1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.

PART 3 – EXECUTION

3.01 GENERAL

- A. Temporary Protection:
 - 1. Provide and maintain protection for the work whether completed or in progress.
 - 2. Provide suitable coverings and enclosures.
- B. Scaffolding, Rigging and Hoisting:
 - 1. Provide all scaffolding, rigging and hoisting services necessary for erection, and/or delivery into the premises, of any equipment and apparatus furnished. Remove from the premises when no longer required.
- C. Waterproofing:
 - 1. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect before work is done. This Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

3.02 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

- A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus requiring access for service and maintenance.
- B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding shall be permitted only when approved by the Architect.
- C. Submit shop drawings of supports for approval to the Architect before fabricating or constructing.
- D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.
- E. Where supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

3.03 ACCESSIBILITY

- A. The installation of electrical equipment, including panelboards, disconnect switches, motor starters, etc., shall be in accordance with the requirements of Article 110 or the National Electrical Code relative to work space around equipment. Equipment which is installed and does not have the working space required by the NEC, shall be relocated by the Contractor at no additional cost to the Owner.

3.04 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof, for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Use of permanent equipment for temporary services must be approved in writing by Owner.

3.05 CODES, RULES, PERMITS & FEES

- A. The Contractor shall give all necessary notices, obtain all permits and filings including, but not limited to, New York State DEP, New York State DEC, New York State and State Building Code requirements, and pay all government sales taxes, fees, and other costs, in connection with his work. However, all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity shall be paid directly to utility companies and/or agencies by the Owner, unless otherwise indicated. The Contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Owner's Representative before request for acceptance and final payment for the work.
- B. The complete design and construction shall conform to the requirements of the NEC, and any other local or state code which may govern.

3.06 INSPECTION AND TESTS

- A. Testing: No equipment shall be tested, or operated for any purpose, until it has been installed in complete accordance with the manufacturer's instructions.

- B. In addition to the tests hereinafter specified, all electrical wiring systems shall be tested in accordance with the manufacturer's recommendations and as required by the Architect.
- C. Notify the Architect seven (7) calendar days prior to any test.
- D. Wiring Systems Tests
 - 1. Perform insulation resistance test on each cable with respect to ground and adjacent cables.
 - 2. Perform continuity test to insure proper cable connection.
 - 3. Insulation resistance tests on 600-volt rated wire shall be performed at 1000 Volts DC for one half minute. All cables shall be tested after termination with ends disconnected from equipment. Minimum acceptable insulation resistance for No. 14 and No. 12 AWG shall be 1,000,000 OHMS and for No. 10 AWG and larger, 250,000 OHMS.
 - 4. Submit schedule of test results for all feeders rated at 100 amps and over. Schedule shall indicate feeder designation, load served, feeder size, feeder length and measured values for each conductor. Individual values shall be indicated for each conductor of multiple phase circuits.
 - 5. Correct or replace any nominal current-carrying circuit that is defective or grounded and also correct all other troubles uncovered by these tests. All defects, whether in faulty workmanship or in material furnished, shall be corrected.
 - 6. For tests on wires rated at more than 600 volts, refer to the Section which they are specified.
- E. Motor Tests
 - 1. Make the following tests on all motors before start-up:
 - a. Check motor nameplates for HP, speed, phase and voltage.
 - b. Check all bearings to see that they are properly filled with oil or grease.
 - c. Check coupling alignment and shaft end play.
 - d. Megger test all motor windings.

2. Make the following tests on all motors during or immediately after start-up:
 - a. Check shaft rotation, bearing temperature and smooth operation.
 - b. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine the reason for the discrepancy and take the necessary corrective action.
 - c. Following established procedures, equipment shall be energized after certification by the Contractor that the installation is satisfactory.
 - d. Overload elements in motor starters shall be adjusted and checked for suitability to the motor characteristics. Replace any overload element that is inadequate. The cause of any motor operating above full load rating shall be investigated and the cause corrected. Increasing the overload trip rating will not be permitted.
3. These final operational tests shall determine that the installation is correct. These tests shall not be made without permission of the Architect.
4. Submit schedule indicating motor designation, motor nameplate horsepower, nameplate full load amps, measured amperes, overload element catalog number and overload element ampere range. Replace all overload elements not applied in accordance with their published values.

F. Transformer Test

1. Prior to energization, test insulation resistance, polarization index and turns ratio to assure that transformer has not been damaged in shipment or storage.
2. Upon energization, all transformers shall be checked for proper tap selection to determine that output voltages are as specified. Taps shall be adjusted as required. Contractor shall recheck voltage after building is occupied. All lugs shall be retorqued and taps adjusted as required. Transformer taps shall be adjusted so that during off peak load periods, transformers provide nominal voltage with tolerance of +1%.

3. Each transformer shall be checked for excessive sound and vibration, and remedial steps taken as required.

G. Grounding System

1. The completed equipment grounding system shall be tested at main distribution panels to insure that the ground resistance does not exceed five (5) ohms. The ground resistance at individual items of utilization equipment shall not exceed ten (10) ohms.
2. Ground resistance tests shall be made at all test points as required by code and also as required by the Architect. Ground resistance tests shall be made in accordance with the test procedures outlined in James G. Biddle Company Bulletins 25T2 and 25-J.

H. Panelboards

1. Compare equipment nameplate information with single line diagram and schedules and report discrepancies.
2. Measure insulation resistance of each bus section phase to phase and phase to ground using test voltage of 1000V DC for one (1) minute.
3. Check ground connections and measure resistance to ground.
4. Check polarities, connections and ratios on all instruments and relays.
5. Verify mechanical and electrical operation on all interlocking systems.
6. Set all circuit breakers, relays and trip devices in accordance with approved coordination study.

I. Miscellaneous Systems Tests

1. Verify operation of all specified functions and safety devices.
2. Obtain, from each manufacturer, written statement confirming that the installation is in accordance with his recommendations and he considers the testing to be satisfactory and successful and in accordance with the Codes. Submit all statements to the Architect.

3. Auxiliary Systems: Low voltage control relays and other systems shall be demonstrated to operate as specified to the satisfaction of the Architect.
4. System Restoration: Contractor shall coordinate and perform System Restoration after Power Loss test. Contractor shall open and then close each Low Voltage Breaker while served systems are on line. With the cooperation of the Mechanical and Control Contractors (and Subcontractors as required), the Contractor shall confirm and document that all served systems return to desired conditions after properly controlled restarts. Systems of special concern for these tests include Fire Alarm System, Building Automation System and Variable Frequency Drives.

3.07 INSTALLATION OF MOTOR STARTERS AND CONTROL DEVICES

A. General

1. Provide wiring for manual motor starters, remote emergency pushbutton stations combination motor starters and variable speed drives specified in the Division 23 Specifications.
2. Make required mechanical and electrical connections including those indicated on approved shop drawing.
3. With clamp-on ammeter, verify loading of motors. Where overloading occurs, do not increase thermal elements unless directed by the Architect.
4. Provide fuses for all motor starters.
5. Where several motor starters are required at one location, they shall be combined onto a min. 4" x 4" wireway.
6. Provide feeder taps in wireway to each combination motor starter as scheduled on the electrical drawings.

B. Remote Maintained Contact Emergency Stop and Reset Pushbuttons

1. Remote maintained contact emergency stop and reset pushbuttons shall be wired ahead of all other motor control devices and shall interrupt the motor control circuit in both the "Hand" and "Automatic" positions.

3.08 FINAL INSPECTION

- A. Contractor shall arrange and schedule final inspection of work and shall notify the Architect in writing that the Contractor has thoroughly checked his work and, in the opinion of the Contractor, is ready for final inspection.
- B. During the entire period schedule for these inspections, the Contractor and representatives of each manufacturer of equipment involved shall be present. All of these organizations shall have sufficient and competent personnel present so that adjustments can be made to all systems without delay.

3.09 ACCEPTANCE

- A. The operation or the temporary use of the equipment and the mechanical and electrical installation, by the Owner does not constitute an acceptance of the work. The final acceptance is to be made after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the Contract Documents, and has furnished all the required Certificates. Warranties and guaranties are effective after the acceptance.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for low-voltage electrical power conductors and cables in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Building Wire and Cable
 - 2. Wiring Connectors and Connections.
- B. Related Sections:
 - 1. Section 260553 - Identification for Electrical Systems: Product requirements for wire identification.

1.02 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriter's Laboratories:
 - 1. UL 83 – Thermoplastic-Insulated Wire and Cables.
 - 2. UL 486A & 486B – Wire Connectors.
 - 3. UL 486C – Splicing Wire Connectors.
 - 4. UL 486D – Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.

5. UL 486E – Standard for Safety for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
6. UL 510 – Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
7. UL 1063 – Standard for Machine-Tool Wires.
8. UL 1569 – Standard for Metal-Clad Cables.
9. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.03 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 14 AWG for control circuits.
5. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type USE-2 or XHHW insulation in raceway.
5. Exterior Locations: Use only building wire, Type USE-2 or XHHW insulation, in raceway.

6. Underground Locations: Use only building wire, Type USE-2 or XHHW insulation in raceway.

1.04 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper.

1.05 SUBMITTALS

- A. Product Data:
 1. Submit for building wire.
 2. Submit for wiring connectors, including insulating materials.
 3. Submit for conductor pulling lubricants.
 4. Submit for tapes, including arc-proofing tapes.
 5. Submit for cable ties.
- B. Test Reports: Indicate procedures and values obtained.
- C. Test Reports: Submit Calibration reports for torque drivers and torque wrenches used for electrical connections. Torque drivers and wrenches shall be lab calibrated prior to use on the project and every three months thereafter.

1.06 CLOSEOUT SUBMITTALS

- A. General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with the National Electrical Code.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. General Conditions and Addendum to General Conditions - Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Subject to the requirements of the specifications, manufacturers offering products that may be suitable for use on this project include, but are not limited to, the following unless otherwise noted:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Southwire, Inc.
 - 5. American Insulated Wire, Inc.
 - 6. Or Approved Equal.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper. Solid for No. 10 AWG and smaller; stranded (class B) for No. 8 AWG and larger.
- D. Insulation Ratings: 600 volt; 90 degrees C.
- E. Insulation Types:
 - 1. Type THHN/THWN or XHHW insulation for feeders and branch circuits No. 6 AWG and larger.
 - 2. Type THHN/THWN for feeders and branch circuits No. 8 AWG and smaller.

3. Type RHW-2/USE-2 for feeders and branch circuits No. 2 AWG and larger, installed under floor slabs or underground.

2.02 WIRING CONNECTORS

A. General:

1. Connectors specified below are for use when lugs are not provided by the equipment manufacturer.
2. Temperature rating of all connections and insulation materials shall not be less than that of the conductors and in no case shall be less than 75 degrees C.
3. Connectors with a copper rating shall be copper with tin-plating.
4. Pre-molded insulators shall be by the same manufacturer as the connector.

B. Compression Splices (copper conductors):

1. FCI Burndy: YS-L or YS series.
2. Thomas & Betts: 54800 or 54500 series.
3. IlSCO: CT or CTL series.

C. Compression Terminations (copper conductors):

1. FCI Burndy: YA, YAZ or YA-2N series.
2. Thomas & Betts: 54100, 54900 or 54800 series.
3. IlSCO: CRA, CRL or CRL2 series.

D. Compression Taps (copper conductors):

1. FCI Burndy: YH or YSH series.
2. Thomas & Betts: CHT series.

E. Lugs, Bolt Type:

1. FCI Burndy, Type KA-U.
2. ILSCO Type TA.

- F. Heat Shrink Tubing:
 - 1. FCI Burndy, Type HS-H-PF.
 - 2. ILSCO Type Heavy Wall.
 - 3. Tyco Electronics/Raychem Type WCSM.
 - 4. Thomas & Betts Type HSFR.
- G. Spring Wire Connectors:
 - 1. Buchanan.
 - 2. Ideal.
 - 3. King Industries.
 - 4. NSI Industries.
 - 5. Thomas & Betts.
 - 6. 3M.
- H. Crimp Type Connectors (power and control wiring, No 10 AWG and smaller):
 - 1. FCI Burndy.
 - 2. Buchanan.
 - 3. ILSCO.
 - 4. Thomas & Betts.

2.03 CONDUCTOR PULLING LUBRICANTS

- A. Description: Water soluble, non-toxic and non-sensitizing wire lubricant with volatile solids less than 6%. The lubricant shall have no flash point in gel state and shall leave a non-flammable residue when dry.
- B. Appearance: Thick gel material, suitable for application with electrically operated pumping equipment.
- C. Useful temperature range: 20 - 100 degrees F.
- D. Lubricant shall be equal to Polywater J lubricant or Ideal AquaGel II.

2.04 TAPE

- A. Insulation tape shall have a minimum of 350 volts per mil dielectric strength. Vinyl tape shall be equal to 3M Scotch No. 33. Tape for conductor phase identification shall be equal to 3M Scotch No. 35.

2.05 ARC/FIREPROOFING TAPE

- A. Subject to the requirements of the specifications, manufacturers offering products that may be suitable for use on this project include, but are not limited to, the following unless otherwise noted:
 - 1. 3M.
 - 2. Plymouth Rubber Company/ Bishop.
 - 3. Or Approved Equal
- B. The tape shall consist of a flexible, unsupported intumescent elastomer. The tape shall be .030 inches thick and shall be capable of 100% elongation. The tape shall be self-extinguishing and shall not support combustion. The tape shall be non-corrosive to metallic cable sheaths and compatible with synthetic cable jackets. The tape shall be secured by a band consisting of two layers of glass cloth electrical tape.
- C. Arc-proofing tape shall be 3M No. 77 with 3M Scotch No. 69 glass cloth tape or Bishop No. 53 with Plymouth/Bishop No. 77 Plyglas glass cloth tape.
- D. All fireproofing tapes shall be products of one manufacturer.

2.06 CABLE SUPPORTS

- A. Cable Supports for Vertical Conduit shall be as specified in Section 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

2.07 CABLE TIES

- A. Cable ties shall be self-locking type with a minimum width of .180 inches.
- B. Ties for general purpose use shall be manufactured using 6/6 nylon. Color for general purpose ties shall be white.
- C. Ties for use in air handling plenums or equipment shall be manufactured using Halar or an equal low smoke density material and shall meet UL 94V-O flammability requirement. Color for plenum rated ties shall be maroon.

D. Cable ties shall be as manufactured by the following:

1. FCI Burndy.
2. Panduit.
3. Thomas & Betts.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General Conditions and Addendum to General Conditions - Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.02 PREPARATION

- A. Conduits and raceways shall be installed and completed prior to the installation of conductors.
- B. Prior to installing cables in conduits, visually inspect conduits for damage. Thoroughly swab conduits and raceways before installing conductors. Verify that bushings are in place and properly secured to prevent damage to conductors.

3.03 APPLICATION

- A. Wires and cables for secondary service, feeders and branch circuits shall be single conductor unless otherwise specified.
- B. Wire and cable for miscellaneous systems, such as Intercom, CATV, CCTV, Fire Alarms, Security Alarm Systems, and Telecommunications are specified in the Technical Specification Sections for those systems.

3.04 GENERAL WIRING REQUIREMENTS

- A. Wiring shall be provided complete from point of service connection to all receptacles, lighting fixtures, power outlets, outlets for future extensions and other devices as shown. Slack wire shall be provided for all future connections. Unless otherwise specified, branch circuit conductors shall

be No. 12 AWG or larger. In outlet boxes for future installations, ends of wires shall be taped and blank covers installed. Type of blank covers in finished areas are to be coordinated with Architect.

- B. Cables shall not be bent either permanently or temporarily during installation to radii less than that recommended by the manufacturer.
- C. Conductors not larger than No. 10 AWG located in branch circuit panelboards, signal cabinets and switchboard shall be bundled. Conductors larger than No. 10 AWG located in switchboard, distribution panels and pullboxes shall be bundled in individual circuits. Bundling and cabling shall be done with cable ties made of self-extinguishing nylon.
- D. Where the length of a homerun, from panel to first circuit, exceeds 75 feet for a 120 volt circuit or 175 feet for a 277 volt and higher voltage circuit, the conductor size shall be minimum No. 10 AWG unless otherwise noted.
- E. Where homerun circuit numbers are shown, such numbers shall be followed in connecting circuits to panelboards. Each branch circuit homerun containing two or more circuits with a common neutral shall be connected to the circuit breakers or switches in a three or four-wire branch circuit panelboard so that no two of the circuits shall be fed from the same phase.
- F. Conductors in distribution panels and switchboards, which are bundled by circuit, shall be provided with arc-proofing as specified below.

3.05 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated. Wire shall be color coded as indicated in Item 3.6 below.
- D. Special Techniques - Building Wire in Raceway:
 - 1. Installation equipment shall be provided to prevent cutting and abrasion of conduits or conductors. Ropes used for pulling of feeders shall be made of polyethylene or other non-metallic material.

2. Pulling lines shall be attached to conductor cables by means of either woven basket grips or pulling eyes attached directly to the conductors. Rope hitches shall not be used.
3. Pull conductors into raceway at same time.
4. Install building wire 4 AWG and larger with pulling equipment.
5. Apply conductor pulling lubricant to conductors 4 AWG and larger as the conductors enter the raceway. For conductors 1/0 AWG and larger, the lubricant shall be mechanically applied with an electric pumping system that applies a uniform coating of lubricant to the conductors, as the conductors enter the conduit.
6. Install vertical conductor supports when installing conductors. Conductor supports shall be installed in accordance with the manufacturer's instructions.
7. Upon completion of conductor pulling, clean wire pulling lubricant from exposed portions of cables. If cables shall not be immediately terminated, cut exposed copper conductor to insulation and seal conductor ends.

E. Special Techniques - Wiring Connections:

1. Perform all connection work in strict accordance with recommendations of manufacturers of the wire and connecting devices, unless otherwise noted.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Clean conductor surfaces before installing lugs and connectors.
4. Apply anti-oxidation inhibitor compound containing copper to all stranded copper wire connections.
5. Install hydraulic compression connectors for copper conductor splices and taps, No. 6 AWG and larger.
6. Utilize hydraulic tools for compression connections in accordance with manufacturers' recommendations. Tools shall be non-removable until completion of the connection and shall leave an embossed mark to verify that proper die has been used.
7. Tools shall provide a hexagonal or circumferential crimp to the connectors. Indentation type tools are not acceptable.

8. Splices, taps and termination lugs shall be insulated with heavy wall heat shrink tubing. Tubing shall overlap the conductor insulation by a minimum of 2-inches. The tubing shall be applied using electric heat guns. Open flames or torches shall not be used.
9. Tighten all busbar and stud connections with Belleville washers, or manufacturer standard washers, utilizing torque wrench or torque indicating washer designed for the purpose by the connector manufacturer.
10. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
11. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Connector Application

1. Wire to busbar for wire sizes No. 1/0 AWG and smaller; hydraulic compression lug.
2. Wire to busbar for wire sizes No. 2/0 AWG and larger; two-hole hydraulic compression lug.
3. Wire to Stud, switch, or circuit breaker; one-hole mechanical lug.
4. Stranded wire, No. 8 AWG or larger splice, tap, or pigtail connection; hydraulic compression connector with heavy-wall heat shrink tubing or pre-molded thermoplastic insulator by connector manufacturer with two half-lapped layers of vinyl tape.

- G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

3.06 WIRE COLOR

- A. The covering of wires and cables shall have a distinctive color code for identification of individual conductors.

- B. Secondary service, feeder and branch circuit conductors throughout the electrical system shall be color coded as follows:

<u>Phase</u>	<u>208/120 Volts</u>	<u>60/120 Volts</u> <u>(Balanced Tech</u> <u>Power)</u>
A	Black	Brown
B	Red	Orange
C	Blue	
Neutral	White	White with tracer
Ground	Green	Green
Isolated	Green with tracer	Green with tracer
Ground		
Neutral of	White with tracer	White with tracer
Ground fault		
circuit		

- C. For conductor sizes No. 6 AWG and smaller, conductor insulation shall be color coded as indicated in the table above.
- D. For conductor sizes No. 4 and larger, conductors shall be identified with colored insulation. As an alternative, colored tape or heat shrink tubing at terminals, splices and boxes may be used. Tape shall be applied half lapped, with a minimum length of 6 inches.
- E. Neutral Conductors: When two or more neutrals are located in one conduit, individually identify each with a color tracer to match the phase conductor and proper circuit number.

3.07 ARC/FIREPROOFING

- A. Where more than one set of cables, that are protected by more than one over-current protective device, are installed in a common equipment enclosure or box and any wire is larger than No. 4 AWG, then all sets of conductors shall be covered with arcproof and fireproof tape. Where necessary to facilitate taping, boxes shall be oversized.
- B. Tape shall be applied in a single layer, one half lapped, or as recommended by the manufacturer to conform to the above requirements. The tape shall be applied with the coated side next to the cable and shall be held in place with a random wrap of one half inch wide, pressure-sensitive fiberglass backed color plastic film tape. This tape shall not support combustion per ASTM.

3.08 MOTOR AND CONTROL WIRING

- A. Provide all wiring to and between motors, starters, disconnect switches and other related electrical equipment except where such items are factory wired.
- B. Provide control wiring at 120 volts or higher for control devices wired with branch circuits serving utilization equipment, unless otherwise specified in other Division of the Specifications.
- C. For control devices operating at voltages lower than 120 volts nominal, refer to the respective Sections.

3.09 FIELD QUALITY CONTROL

- A. In addition to any testing specified elsewhere in these Specifications, the Contractor shall perform basic testing of his work.
- B. Contractor shall verify the continuity of all branch circuit wiring.
- C. Contractor shall verify that branch circuits are properly terminated.
- D. Measure the tightness of all conductor terminations using calibrated torque drivers or torque wrenches.
- E. Verify the insulation integrity of all feeders using a 1,000 volt insulation resistance tester. Digital multi-meters shall not be used to verify insulation integrity.
- F. Inspect and test in accordance with NETA ATS, except Section 4.
- G. Perform inspections and tests listed in NETA ATS, Section 7.3.2.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for grounding and bonding for electrical systems in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Rod electrodes.
 - 2. Wire.
 - 3. Mechanical connectors.
 - 4. Exothermic connections.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.03 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipes (Domestic water and Fire Protection).
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.

4. Rod electrode.

1.04 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.05 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with National Electrical Code requirements.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum ten years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum ten years documented experience.

1.09 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to commencing work of this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.11 COORDINATION

- A. Complete installation of conduits for bonding structural steel prior to placement of footing and foundations.
- B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.01 ROD ELECTRODES

- A. Subject to the requirements of the specifications, manufacturers offering products that may be suitable for use on this project include, but are not limited to, the following unless otherwise noted:
 - 1. Erico Inc.
 - 2. Copperweld, Inc.
 - 3. O-Z Gedney Co.
 - 4. Thomas & Betts, Inc.
- B. Product Description:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch (19 mm).
 - 3. Length: 10 feet (3.0 m).
- C. Connector: All buried ground connections shall be exothermic weld type.

2.02 GROUND BUS

- A. Ground bus shall be solid-copper bar, 1/4" x 4" x 2'-6" long. Bus shall be drilled and tapped for two-hole hydraulic compression lugs.

2.03 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: No 4/0 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.

- D. Bonding Conductor: Copper conductor bare.

2.04 MECHANICAL CONNECTORS

- A. Water Pipe Connectors shall be constructed using a copper or bronze clamp, a silicon bronze u-bolt and a cable clamping mechanism. Ground clamps shall be equal to FCI Burndy Type GAR or Type GD.
- B. Hydraulic compression connectors shall be solid copper lugs, hydraulically compresses onto the conductor. Lugs shall be two-hole type with NEMA standard spacing. Bolts, nuts and flat washers shall be silicon bronze. Provide cupped, spring steel (Belleville) washers for each bolt.

2.05 EXOTHERMIC CONNECTIONS

- A. Subject to the requirements of the specifications, manufacturers offering products that may be suitable for use on this project include, but are not limited to, the following unless otherwise noted:
 - 1. Cadweld/Erico Products, Inc.
 - 2. Furseweld/Thomas & Betts, Inc.
 - 3. Or Approved Equal.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.02 PREPARATION

- A. Remove paint, rust, mill oils and surface contaminants at connection points.

3.03 INSTALLATION

- A. Install in accordance with IEEE 142.

- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground. Top of ground rods shall be 2'-6" (minimum) below finish grade.
- C. Bond building steel frame and incoming water service pipes (domestic and fire protection) to main grounding bus.
- D. Install grounding and bonding conductors concealed from view. Ground conductors shall be run 2'-6" (minimum) below finish grade.
- E. Install 4/0 AWG bare copper wire, exothermically welded to steel piles in pile cap as indicated on the Drawings. All reinforcing steel in the pile cap shall be bonded together with exothermic weld connections.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- H. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- I. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel. The isolated ground conductor is in addition to the general ground conductor.
- J. Accomplish grounding of electrical system by using insulated grounding conductor installed with all feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NFPA 70, Table 250.122. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment.
- K. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform leakage current tests in accordance with NFPA 99.

- E. Perform continuity testing in accordance with IEEE 142.
- F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for hangers and supports for electrical systems in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
- B. Related Sections:
 - 1. Section 078413 "Penetration Firestopping."

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.03 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- B. Product Data:
 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of trapeze hangers, hangers and supports.
- D. Manufacturer's Installation Instructions:
 1. Hangers and Supports: Submit special procedures and assembly of components.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.01 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company.
3. O-Z/Gedney Co.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

1. Size: Working load of rod support shall not exceed values below:

C. Rod Diameter Maximum Load

3/8"	610 lbs.
1/2"	1130 lbs.
5/8"	1810 lbs.
3/4"	2710 lbs.

D. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

E. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

F. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

G. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.02 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Unistrut Corp.
4. Kindorf.

- B. Product Description: 12 gauge (2.8 mm) thick steel. 1-1/2 inch by 1-1/2" inch or 1-1/2" by 3", as required for safe support of load.
- C. Finish: Galvanized or epoxy coated for interior spaces; Stainless steel 304 for outdoor use.
- D. Hardware such as bolts, nuts, washers, conduit clamps, beam clamps, etc., shall be manufactured of the same material as the channel.

2.03 SLEEVES

- A. Sleeves through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
- B. Sleeves through Walls, Footings, and Potentially Wet Floors: Schedule 40 Steel pipe; Schedule 40 stainless steel pipe for wet areas and below grade penetrations.
- C. Sleeves for through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Schedule 40 steel pipe, minimum two trade sizes larger than penetrating pipe.
- D. Sleeves for through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: For cables not in conduit, provide pre-fabricated fire rated sleeves including seals, UL listed.
- E. Fire-stopping Insulation: Mineral wool, non-combustible.

2.04 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive sleeves.

3.02 PREPARATION

- A. Obtain permission from Architect before drilling or cutting structural members.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts, expansion anchors, and preset inserts.
2. Steel Structural Elements: Provide beam clamps or welded fasteners. Welded fasteners shall be reviewed by the Structural Engineer prior to installation.
3. Concrete Surfaces: Provide expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

- B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

- C. Install conduit and raceway support and spacing in accordance with NFPA 70, except spacing of supports for EMT shall not exceed 8'-0" on center.

- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

- E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
4. Support vertical conduit at every floor.

3.04 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with mineral wool insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install escutcheons at finished surfaces.

3.05 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.
- B. Related Sections:
 - 1. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 2. Section 260529 - Hangers and Supports for Electrical Systems.
 - 3. Section 260553 - Identification for Electrical Systems.
 - 4. Section 262716 - Electrical Cabinets and Enclosures.
 - 5. Section 262726 - Wiring Devices.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
 - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

5. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
6. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. National Fire Protection Association:
 1. NFPA 70 – The National Electric Code.
- D. Underwriters Laboratories, Inc.
 1. UL 1 – Standard for Flexible Metal Conduit.
 2. UL 5 – Standard for Surface Metal Raceways and Fittings.
 3. UL 6 – Standard for Electrical Rigid Metal Conduit.
 4. UL 360 – Standard for Liquid-Tight Flexible Steel Conduit.
 5. UL 467 – Standard for Grounding and Bonding Equipment.
 6. UL 514B – Standard for Fittings for Cable and Conduit.
 7. UL 651 – Standard for Schedule 40 and 80 Rigid PVC Conduit.
 8. UL 797 – Standard for Electrical Metallic Tubing – Steel.
 9. UL 1242 – Standard for Electrical Intermediate Metal Conduit – Steel.

1.03 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground More than 5 feet (1500 mm) outside Foundation Wall: Provide thick wall non-metallic conduit (Schedule 40 PVC) for feeders and branch circuits. Provide rigid steel elbows for stub-up to above grade. Feeders shall be concrete encased. Provide cast metal boxes.
- C. Underground within 5 feet (1500 mm) of Foundation Wall: Provide Rigid Steel Conduit. Provide cast metal boxes.
- D. In or Under Slab on Grade: Provide thick wall non-metallic conduit (schedule 40 PVC) encased in concrete. Provide rigid steel conduit stub-up through floor slab.

- E. Outdoor Locations, Above Grade: Provide rigid steel conduit. Provide cast metal outlet, pull, and junction boxes.
- F. In Slab above Grade: Provide thick wall non-metallic conduit (schedule 40 PVC). Provide rigid steel conduit stub-up through floor slab. Conduit shall be installed in accordance with details on drawing and in coordination with structural trade. Submit layout plan of all in slab conduits for review and approval by architect.
- G. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Conduits in masonry walls shall be rigid galvanized steel.
- I. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- J. Exposed Dry Locations: Provide rigid steel conduit. Conduits on wall shall be secured with two-hole conduit straps. Provide sheet-metal boxes. Provide hinged enclosure for large pull boxes.
- K. Connections requiring vibration isolation or flexibility for service: Liquid-tight flexible metal conduit.

1.04 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch (19 mm) unless otherwise specified.
- B. All conduits shall be concealed unless otherwise indicated on the drawings.

1.05 SUBMITTALS

- A. Product Data: Submit for the following:
 - 1. Rigid galvanized steel conduit.
 - 2. Liquid-tight flexible metal conduit.
 - 3. Non-metallic conduit and fittings.
 - 4. Solvent Cement and primer for non-metallic conduit.
 - 5. Raceway fittings.
 - 6. Conduit bodies.
 - 7. Surface raceway.

- 8. Wireway.
- 9. Pull and junction boxes.
- 10. Handholes.
- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
- C. Layout drawings of all in-slab conduits.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch (51 mm).
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.
 - 3. Record actual routing of all in-slab and below slab conduits.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 00 00 – General Conditions: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.08 COORDINATION

- A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.
- B. Coordinate installation of in-slab and below-slab conduits with all trades.

PART 2 PRODUCTS

2.01 METAL CONDUIT

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

- B. Conduit – Metallic:
 - 1. Allied Tube and Conduit Corporation.
 - 2. Triangle Wire and Cable Co.
 - 3. Republic Conduit.
 - 4. Wheatland Conduit.
 - 5. Or Approved Equal.
- C. Conduit – Metallic Fittings:
 - 1. Bridgeport.
 - 2. Cooper/Crouse-Hinds.
 - 3. Thomas & Betts Corporation.
 - 4. O-Z/Gedney.
 - 5. Appleton Electrical Products.
 - 6. Or Approved Equal.
- D. Conduit – Hazardous Location Metallic Fittings:
 - 1. Appleton Electric.
 - 2. Cooper/Crouse-Hinds.
 - 3. O-Z/Gedney.
 - 4. Thomas & Betts Corporation.
 - 5. Or Approved Equal.
- E. Rigid Steel Conduit: ANSI C80.1.
- F. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.
- G. Conduit seal fittings shall be malleable iron, hot-dipped galvanized with a filler plug and breather/drain opening. Breather/drain fitting shall be stainless steel. Vertical seal fittings shall be O-Z/Gedney Type EYDX or Approved Equal. Sealing fiber shall be utilized to separate the conductors and to form a dam to allow the poured sealing compound to harden. Sealing fiber shall be O-Z/Gedney type EYF. Sealing

compound shall be a pourable sealing compound with a quick curing time of approximately 1 hour at 70 degrees F. Sealing compound shall be O-Z/Gedney Type EYC or approved equal.

- H. Flexible couplings shall be constructed of stainless steel tubing and an outer braid with an insulating liner. Stainless steel female end fittings shall be supplied with removable steel close nipples. Flexible couplings shall be used to provide vibration isolation. Flexible couplings shall be O-Z/Gedney Type ECGJH or Approved Equal.

2.02 PVC COATED METAL CONDUIT

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. RobRoy Industries.
 - 2. AMCO Corporation.
 - 3. Or Approved Equal.
- B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mils (0.1 mm) thick and an internal PVC coating of 20 mils.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. AFC Cable Systems.
 - 2. Alfex Corporation.
 - 3. Electri-Flex Company.
 - 4. Or Approved Equal.
- B. Product Description: Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1; steel or cast iron with zinc coating. Die-cast zinc fittings are not permitted.

2.04 ELECTRICAL METALLIC TUBING (EMT)

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Allied Tube and Conduit Corporation.
 - 2. Triangle Wire and Cable Co.
 - 3. Republic Conduit.
 - 4. Wheatland Conduit.
 - 5. Or Approved Equal.
- B. Product Description: ANSI C80.3; galvanized steel tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type. Die-cast zinc fittings are not permitted. Set screw fittings shall not be used.

2.05 NON-METALLIC CONDUIT

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Carlon Products Company.
 - 2. Cantex.
 - 3. Allied Tube and Conduit.
 - 4. PW Eagle.
 - 5. Or Approved Equal.
- B. Product Description: NEMA TC 2; Schedule 40 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3; fittings shall match the conduit schedule.

2.06 SURFACE METAL RACEWAY

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Hubbell, Inc.

2. Panduit Corporation.
 3. The Wiremold Company.
 4. Or Approved Equal.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway. Raceway shall be provided with an internal metal divider to separate low-voltage cabling from line voltage conductors.
- C. Size: 4.75 x 1.75 inch (120 x 45 mm).
- D. Finish: Gray enamel.
- E. Fittings, closures and device mountings: Furnish manufacturer's standard accessories; match finish on raceway.
- F. Equal to Wiremold G-4000 Series.
- G. Plugmold shall be pre-wired surface metal raceway with single NEMA 5-15R receptacles at 18-inches on center. All receptacles shall be wired on a single circuit with a ground conductor.
- H. Size: 0.875 x 1.906 inches (22 x 48 mm).
- I. Finish: Ivory enamel.
- J. Fittings and closures: Furnish manufacturer's standard accessories; match to finish on raceway.
- K. Equal to Wiremold V24GB618.

2.07 WIREWAY

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
1. Hammond Manufacturing.
 2. Hoffman.
 3. Schneider Electric/Square D.
 4. The Wiremold Company.
 5. Or Approved Equal.
- B. Product Description: General purpose type wireway.
- C. Knockouts: None.

- D. Size: as indicated on the drawings, but not less than 6 x 6 inch (150 x 150 mm); length as indicated on Drawings.
- E. Cover: Screw cover.
- F. Connector: Slip-in.
- G. Fittings: Lay-in type with removable side; captive screws.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.08 OUTLET BOXES

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Hubbell/Raco.
 - 2. Thomas & Betts/Steel City.
 - 3. Or Approved Equal.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required. Minimum box size shall be 4" Octagonal, 1-1/2" deep.
 - 2. Concrete Ceiling Boxes: Concrete type.
 - 3. Minimum box size shall be 4" x 4" x 1-1/2" deep.
 - 4. Provide Extension rings as required to accommodate wall thickness.
- C. Cast Boxes: NEMA FB 1, Type FD, cast iron alloy with threaded hubs, zinc coated. Furnish gasketed cover, UL Listed as "in-use" for receptacles.
- D. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.09 PULL AND JUNCTION BOXES

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Hammond Manufacturing.

2. Hoffman.
3. Or Approved Equal.
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: Where specified on drawings.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
 1. Material: Galvanized cast iron.
 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- E. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:
 1. Material: Galvanized cast iron.
 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 3. Cover Legend: "ELECTRIC" or "Communications" as required.
- F. Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
 1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
 2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General Conditions and Addendum to General Conditions - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 INSTALLATION

- A. Install Work in accordance with the National Electric Code.
- B. Ground and bond raceway and boxes in accordance with Section 26 05 26.

- C. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- D. Identify raceway and boxes in accordance with Section 26 05 53.
- E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.03 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Unless otherwise indicated, all raceway shall be concealed in walls or above ceilings in all finished spaces.
- C. Arrange raceway supports to prevent misalignment during wiring installation.
- D. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- F. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- G. Do not attach raceway to ceiling support wires or other piping systems.
- H. Construct wireway supports from steel channel specified in Section 26 05 29.
- I. Route exposed raceway parallel and perpendicular to walls.
- J. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- K. Route conduit in and under slab from point-to-point.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.

- P. Join non-metallic conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Provide hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- U. Install suitable 250 pound test polypropylene pull line in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.04 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings or specified in section for outlet device.
- B. Adjust box location up to 10 feet (3 m) prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Install conduits to recessed outlet boxes such that all threaded fittings are used. Typically, the conduit shall exit the wall one block course below the top of the wall.

- E. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- F. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- G. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- H. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- J. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- L. Install adjustable steel channel fasteners for hung ceiling outlet box.
- M. Do not fasten boxes to ceiling support wires or other piping systems.
- N. Support boxes independently of conduit.
- O. Install gang box where more than one device is mounted together. Do not use sectional box.
- P. Install gang box with plaster ring for single device outlets.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Architectural reflected ceiling plan.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.06 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.07 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for identification for electrical systems in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

1.02 SUBMITTALS

- A. General Conditions and Addendum to General Conditions - Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.03 CLOSEOUT SUBMITTALS

- A. General Conditions and Addendum to General Conditions - Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with NEC.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General Conditions and Addendum to General Conditions - Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Install labels only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.08 EXTRA MATERIALS

- A. General Conditions and Addendum to General Conditions - Requirements for extra materials.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Or Approved Equal.

- B. Product Description: Laminated three-layer plastic with engraved black letters on white background color. Yellow letters on a red background for emergency equipment. Black letters on a yellow background for standby power.
- C. Letter Size: See Nameplate Type Schedule below.
- D. Minimum nameplate thickness: 1/8.

2.02 LABELS

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Approved Equal
- B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.03 WIRE MARKERS

- A. Manufacturers:
 - 1. Seton.
 - 2. Brady.
 - 3. Approved Equal
- B. Description: Cloth tape, split sleeve type wire markers.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on shop drawings.

2.04 UNDERGROUND WARNING TAPE

- A. Provide 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.02 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
 - 4. Secure nameplate to equipment front using screws.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

3.03 NAMEPLATE SCHEDULE

- A. Nameplates shall be provided for the following electrical equipment:

<u>ITEM</u>	<u>NAMEPLATE</u>
	<u>TYPE</u>
1. Distribution panelboards	A
2. Main and branch over current devices in distribution panelboards.	B
3. Lighting, receptacle and power panelboards	A
4. Dry type transformers	C
5. Safety switches	B
6. Spare fuse cabinets	E
7. Pullboxes and cable tap boxes	F
8. Pushbuttons, pilot lights, etc. for motor controls	H
9. Control panels	G

B. Nameplate Type Schedule:

'A'	Line 1:	Equipment Designation (1" high letters)
	Line 2:	Voltage, phase, No. wires (1/2" high letters)
	Line 3:	Incoming feeder designation (1/2" high letters)
'B'	Line 1:	Load description (1/4" high letters)
	Line 2:	Breaker trip or fuse rating (1/4" high letters)
'C'	Line 1:	Transformer KVA rating (1" high letters)
	Line 2:	Designation of panel served (1/2" high letters)
	Line 3:	Incoming feeder designation (1/2" high letters)
'D'		NOT USED
'E'	Line 1:	"Spare Fuse Cabinet" (1" high letters)
'F'	Line 1:	Feeder designations (1/4" high letters)
'G'	Line 1:	Cabinet Designation (1" high letters)
'H'	Line 1:	Description of operation and equipment controlled (1/2" high letters)

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:

1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
3. Install labels at data outlets identifying patch panel and port designation.

E. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for panelboards in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:

1. Distribution Panelboards.
2. Branch Circuit Panelboards.
3. Technical Power Panelboards.

- B. Related Sections:

1. Section 260526 - Grounding and Bonding for Electrical Systems.
2. Section 260553 - Identification for Electrical Systems.
3. Section 262813 - Fuses.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

- B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.

7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories Inc.:
 1. UL 67 - Safety for Panelboards.
 2. UL 1283 - Electromagnetic Interference Filters.
 3. UL 1449 - Transient Voltage Surge Suppressors.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate manufacturer's panelboard type, outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes. Indicate circuit breaker handle locking devices, shunt trip coils and any other required options or accessories.
- B. Product Data: Submit catalog data showing specified features of standard products.
- C. Provide calibration reports for torque wrenches or torque drivers for tightening termination and connectors.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.06 MAINTENANCE MATERIALS

- A. General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards shall be keyed alike.
- C. Panelboards identified for use as service equipment are to be listed and labeled for use as service entrance equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to the requirements of this specification, manufacturers offering products that may be incorporated into this project include, but are not limited to, the following:
 - 1. General Electric Company.
 - 2. Schneider Electric/Square D.
 - 3. Siemens.
 - 4. Eaton Corporation/Cutler-Hammer.

2.02 DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER

- A. Product Description: NEMA PB 1, circuit breaker type panelboard.
- B. Panelboard Bus: Tin/Silver plated Copper current carrying components, ratings as indicated on Drawings. Furnish an isolated copper neutral bus in panelboards where a neutral bus is required.
- C. Furnish copper ground bus in each panelboard. Ground bus shall be bare, un-insulated and suitably bolted to the cabinet. Provide suitable lugs for each feeder ground conductor and each outgoing feeder or branch circuit.
- D. Minimum integrated short circuit rating: 65,000 amperes RMS symmetrical for 208 volt panelboards unless noted otherwise on drawings.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

- F. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings. All circuit breakers shall be equipped with lock-out/tag-out devices. Provide Main circuit breakers, where indicated, with Kirk-Key interlock systems to prevent both main breakers from being simultaneously closed.
- G. All interiors shall be completely factory assembled with switching and protective devices, connectors, etc. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units, without removing the main bus connectors, and shall be so designed that circuits may be changed without machining, drilling or tapping.
- H. Enclosure: NEMA PB 1, Type 1, 10 inches (250 mm) deep, 36 inches (900 mm) wide, cabinet box.
- I. Cabinet Front: Door-in-door trim, bolted to the cabinet. Finish in manufacturer's standard gray enamel. Each door shall be provided with Yale 511S locks with 47 key. Locks shall be provided as follows:
 - 1. For doors less than 30-inches – Provide one lock.
 - 2. For Doors 30 to 48-inches – Provide two locks.
 - 3. For doors greater than 48-inches – Provide three locks.
- J. Distribution Panelboards shall be equal to Schneider Electric/Square D I-Line Type HCM.
- K. Switching and protective devices can be replaced without disturbing adjacent units, without removing the main bus connectors, and shall be so designed that circuits may be changed without machining, drilling or tapping.
- L. Panelboards identified for use as service equipment are to be listed and labeled for use as service entrance equipment.

2.03 BRANCH CIRCUIT PANELBOARDS

- A. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- B. Panelboard Bus: Tin/silver plated Copper current carrying components, ratings as indicated on Drawings. All panelboard shall be furnished with an insulated copper neutral bus, suitable for individual neutral

connections for each branch circuit. Furnish copper ground bus in each panelboard.

- C. Minimum Integrated Short Circuit Rating: 22,000 amperes RMS symmetrical for 240 volt panelboards. Series rated panelboards shall not be accepted.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- E. Enclosure: NEMA PB 1, Type 1.
- F. Cabinet Box: 6 inches (153 mm) deep, 20 inches (508 mm) wide. Dimensions are nominal, but shall not vary by more than 1/2-inch.
- G. Cabinet Front: Door-in-door trim, bolted to the cabinet. Finish in manufacturer's standard gray enamel. Each door shall be provided with standard locks and keyed alike. Locks shall be provided as follows:
 - 1. For doors less than 30-inches – Provide one lock.
 - 2. For Doors 30 to 48-inches – Provide two locks.
 - 3. For doors greater than 48-inches – Provide three locks.
- H. Panelboards shall be equal to Schneider Electric/Square D Type NQOD for 240 volt panelboards, operating at 208V/120, 3-phase, 4-wire.
- I. Panelboards identified for use as service equipment are to be listed and labeled for use as service entrance equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet (1800 mm) to handle of highest circuit breaker. Install panelboards a minimum of 4 inches (100 mm) above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch conduits. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.02 FIELD QUALITY CONTROL

- A. General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.03 ADJUSTING

- A. General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for wiring devices in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Wall switches
 - 2. Wall box dimmers
 - 3. Receptacles
 - 4. Multi-outlet assemblies
 - 5. Device plates
 - 6. Decorative box covers.
- B. Related Sections:
 - 1. Section 260533 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.
 - 2. Section 260533 - Raceway and Boxes for Electrical Systems: Service fittings for receptacles installed on floor boxes.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. Underwriter's Laboratories, Inc.:
 - 1. UL 943 – Standards for Ground-Fault Circuit Interrupters.

1.03 SUBMITTALS

- A. General Conditions and Addendum to General Conditions - Submittal procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.05 EXTRA MATERIALS

- A. Furnish two (2) of each style, size, and finish wall plate.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Products provided under this Section shall be from one manufacturer for identical catalog items (i.e. receptacles); wherever possible, provide uniformity of manufacturer for similar types of items.
- B. Plugs shall be of same manufacturer and grade as receptacles.
- C. The color of the wiring devices shall be as selected by the Architect from the manufacturer's standard colors.

2.02 WALL SWITCHES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
 - 1. Cooper Wiring Devices
 - 2. Hubbell
 - 3. Leviton
 - 4. Pass & Seymour (LeGrand)
 - 5. Or Approved Equal.
- B. Description:
 - 1. Heavy-duty, AC only general-use snap switch, quiet operation type, back and side wired.
 - 2. Voltage: 120/277 volts, AC.
 - 3. Current: 20 amperes.

4. Horsepower rating: 1 HP@120V; 2 HP@277V.
 5. Body and Handle: Thermoplastic with a nylon toggle handle. Handle color shall be White. The color of wiring devices installed in millwork shall be as selected by the Architect from the manufacturer's standard colors.
- C. Single Pole Switch:
1. Cooper No. CSB120.
 2. Hubbell No. CSB120.
 3. Leviton No. CSB1-20
 4. Pass & Seymour No. CSB20AC1.
- D. Double Pole Switch:
1. Cooper No. CSB220.
 2. Hubbell No. CSB220.
 3. Leviton No. CSB2-20
 4. Pass & Seymour No. CSB20AC2.
- E. Three-way Switch:
1. Cooper No. CSB320.
 2. Hubbell No. CSB320.
 3. Leviton No. CSB3-20
 4. Pass & Seymour No. CSB20AC3.
- F. Four-way Switch:
1. Cooper No. CSB420.
 2. Hubbell No. CSB420
 3. Leviton No. CSB4-20
 4. Pass & Seymour No. CSB20AC4.
- G. Pilot Light Switch, Single Pole, red polycarbonate handle (Switch Handle glows when in ON position):
1. Cooper No. 2221PL.
 2. Hubbell No. HBL1221PL.

3. Leviton No. 1221-PLR.
 4. Pass & Seymour No. PS20AC1RPL.
- H. Pilot Light Switch, 3-way, red polycarbonate handle (Switch Handle glows when in ON position):
1. Cooper No. 2223PL.
 2. Hubbell No. HBL1223PL.
 3. Leviton No. 1223-PLR.
 4. Pass & Seymour No. PS20AC3RPL.

2.03 RECEPTACLES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:
1. Cooper Wiring Devices.
 2. Hubbell.
 3. Leviton.
 4. Pass & Seymour (LeGrand).
 5. Or Approved Equal.
- B. Product Description:
1. NEMA WD 1, Heavy-duty; general use receptacle.
 2. Wide double blade contacts designed to maintain positive pressure against both sides of plug or cap having flat fingers. Contacts shall be solid brass.
 3. Polarized grounding type with grounding contacts bonded to receptacle mounting strap, except isolated ground receptacles. Mounting strap shall be nickel plated brass.
 4. Contacts separated by impact resisting molded plastic insulating material.
 5. Receptacles shall be back and side wired; provide a green base ground screw terminal and a nylon face.

6. General Receptacle Types: Rating in amperes, number of poles and wires, voltage, NEMA configuration, description and manufacturer's catalog numbers as indicated below.
 7. Configuration: NEMA WD 6.
 8. GFCI Receptacle: Duplex convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. GFCI receptacles shall be feed-through type.
 9. Color of receptacles shall be white. The color of wiring devices installed in millwork shall be as selected by the Architect from the manufacturer's standard colors.
- C. Duplex Convenience Receptacle, NEMA 5-20R:
1. Cooper No. CR5362.
 2. Hubbell No. HBL5362.
 3. Leviton No. 5362.
 4. Pass & Seymour No. PS5362.
- D. Duplex GFCI Convenience Receptacle, NEMA 5-20R:
1. Cooper No. VGF20.
 2. Hubbell No. GF20_L.
 3. Leviton No. 7899.
 4. Pass & Seymour No. 2095SI.
- E. Single Twist-lock Receptacle, NEMA L6-30R, color shall be black:
(Provide NEMA configurations as noted on plans)
1. Cooper No. CWL630R.
 2. Hubbell No. HBL2620.
 3. Leviton No. 2620.
 4. Pass & Seymour No. L630R.

2.04 WALL PLATES

- A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:

1. Cooper Wiring Devices.
 2. Hubbell.
 3. Pass & Seymour.
 4. Leviton.
- B. Decorative Cover Plate: 302 stainless-steel. Cover plates for wiring devices installed in millwork shall be selected by the Architect.
- C. Weatherproof Cover Plate: In-use type, thermoplastic for single GFI receptacle or light switch.
1. Cooper No. WIU-2.
 2. Hubbell No. RW57500.
 3. Leviton No. 5976-CL.
 4. Pass & Seymour No. WIUC10CL.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

- A. Clean debris from outlet boxes.

3.03 INSTALLATION

- A. Install devices plumb and level.
- B. All devices in CMU walls shall be flush mounted with concealed conduit runs.
- C. Install switches with OFF position down.
- D. Gang multiple switches together where located in same location.
- E. Install receptacles with grounding pole on bottom.

- F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- H. Connect wiring devices by wrapping solid conductor around screw terminal. Install solid conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.
- B. Coordinate installation of wiring devices with floor box service fittings.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.06 ADJUSTING

- A. General Conditions and Addendum to General Conditions - Testing, adjusting, and balancing.
- B. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

- A. General Conditions and Addendum to General Conditions - Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

- C. Replace receptacles and switches that have been painted over.

END OF SECTION

SECTION 262813 - FUSES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes fuses and spare fuse cabinet in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
- B. Underwriter's Laboratories, Inc.
 - 1. UL 248-8 – Low-Voltage Fuses – Part 8: Class J Fuses.
 - 2. UL 248-10 – Low-Voltage Fuses – Part 10: Class L Fuses.
 - 3. UL 248-12 – Low-Voltage Fuses – Part 12: Class R Fuses.
 - 4. UL 248-14 – Low-Voltage Fuses – Part 14: Supplemental Fuses.

1.03 FUSE PERFORMANCE REQUIREMENTS

- A. Main Service Switches Larger than 600 amperes: Class L (time delay).
- B. Main Service Switches Less than 600 amperes: Class RK1 (time delay).
- C. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- D. Power Load Feeder Switches Less than 600 amperes: Class RK1 (time delay).
- E. Motor Load Feeder Switches: Class RK1 (time delay).
- F. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
- G. Lighting Load Feeder Switches Less than 600 amperes: Class RK1 (time delay).
- H. Motor Branch Circuits: Class RK1 (time delay).
- I. Exterior Lighting Branch Circuits (at light poles): Class CC.

1.04 SUBMITTALS

- A. Product Data: Submit data sheets showing electrical characteristics, including time-current curves. Submit selectivity charts and fuse sizing charts for the various fuse types.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.07 MAINTENANCE MATERIALS

- A. Furnish two fuse pullers.

1.08 EXTRA MATERIALS

- A. Furnish six spare fuses of each Class, size, and rating installed.

PART 2 - PRODUCTS

2.01 FUSES - GENERAL

- A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Cooper Industries - Bussmann.
 - 2. Ferraz-Shawmut.
 - 3. Littelfuse.
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. All fuses shall have an interrupting rating of 200,000 amperes RMS Symmetrical.
- D. All fuses shall be UL Listed.
- E. All fuses utilized on the project shall be products of one manufacturer.
- F. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.02 CLASS RK1 (TIME DELAY) FUSES

A. Manufacturers:

1. Bussmann Type LPN-RK (250V) or Type LPS-RK (600V).
2. Ferraz-Shawmut A2D (250V) or A6D (600V).
3. Littelfuse Type LLN-RK (250V) or Type LLS-RK (600V).

B. Description: Dual-Element time-delay, current limiting, rejection type.

2.03 CLASS J (TIME DELAY) FUSES

A. Manufacturers:

1. Bussmann Type LPJ (600V).
2. Littelfuse Type JTD (600V).

B. Description: Dual element, time delay fuse; current limiting.

2.04 CLASS L (TIME DELAY) FUSES

A. Manufacturers:

1. Bussmann Type KRP-C (600V).
2. Littelfuse Type KLP-C (600V).
3. Ferraz-Shawmut A4BQ (600V).

B. Description: Time-delay (minimum 4 sec at 500% of rating), current limiting, machined end bells with o-ring inlays, silver plated terminals.

2.05 CLASS CC (TIME DELAY) FUSES

A. Manufacturers:

1. Bussmann Type LP-CC (600V).
2. Ferraz-Shawmut ATDR (600V).
3. Littelfuse Type KLDR (600V).

B. Description: Time-delay fuse; rejection type.

2.06 SPARE FUSE CABINET

A. Manufacturers:

- B. Product Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
- C. Doors: Hinged with hasp for Owner's padlock.
- D. Finish: Manufacturer's standard baked enamel finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fuse with label oriented so manufacturer, type, and size are easily read.
- B. Promptly replace all fuses cleared during construction for whatever cause.

3.02 FUSE TYPE

- A. The type of fuses required for each application, are given in the Specification Sections where equipment requiring fuses are specified.
- B. If the fuse type is not identified, provide UL Class RK-1 fuses.

3.03 SPARE FUSE CABINET

- A. Install spare fuse cabinet in Building Storage Room.

END OF SECTION

SECTION 262819 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included: This section includes requirements for enclosed switches in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
 - 1. Fusible Switches
 - 2. Non-Fusible Switches.
- B. Related Sections:
 - 1. Section 262813 - Fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriter's Laboratory, Inc:
 - 1. UL-98 - Enclosed and Dead-Front Switches.

1.03 SUBMITTALS

- A. Product Data: Submit switch ratings and enclosure dimensions.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Corporation/Cutler-Hammer.
 - 2. General Electric Company.
 - 3. Schneider Electric/Square D.
 - 4. Siemens.

2.02 FUSIBLE SWITCH ASSEMBLIES

- A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter switch. Handle lockable in OFF position.
- B. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard enamel unless otherwise noted.
 - 1. Interior Dry Locations: NEMA Type 1.
 - 2. Exterior Locations: NEMA Type 4X stainless steel.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.

2.03 NON-FUSIBLE SWITCH ASSEMBLIES

- A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter switch. Handle lockable in OFF position.

- B. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard enamel unless otherwise noted.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4X stainless steel.
- C. Furnish switches with entirely copper current carrying parts.

2.04 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 RMS symmetrical amperes when used with or protected by Class RK-1 or Class J fuses; 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (601 to 1200 ampere).

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet (1500 mm) to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 265000 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: This Section specifies requirements for lighting fixtures, lamps, and accessories in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The work of this Section shall include but not limited to the following:
1. The Contractor shall provide all labor, materials, equipment and services required to furnish and install all lighting systems, fixtures, lamps, accessories, and all related work in strict accordance with the contract documents.
 2. The Contractor shall be responsible for all lighting fixtures quantities, lengths and clearances required and shall inform, the Architect in writing, at the time the bid submission is made, of any discrepancies or variances found with fixtures or details specified herein or in the lighting fixture schedule and other contract documents, which affect installation or location of lighting fixtures.
 3. The General Documents and General Requirements apply to this Section. Consult them in detail for applicable instructions.
- B. Related Sections:
1. Section 262726 - Wiring Devices.
 2. Section 260533 - Raceways and Boxes for Electrical Systems.

1.2 FACTORY TESTS AND TESTS AFTER INSTALLATION

- A. All equipment, including housings, mounting hardware, sockets, ballasts, transformers, and reflectors systems shall be tested at place of manufacture and shall demonstrate that such equipment, when installed, shall comply with contract documents. If any equipment fails, under test, to meet the contract requirements or to function properly, the defects shall be rectified by readjusting, or removing and replacing the faulty equipment until, under test, the requirements are met.

1.3 REFERENCE STANDARDS

- A. Codes:
1. Lighting fixtures, components and installation shall be made in accordance with the American National Standards Institute, the latest revision of the National Electrical Code, and any applicable Federal, State, and Local codes and regulations.

B. U.L. Listing:

1. All Lighting fixtures, ballasts, transformers, and other electrical components shall be manufactured in strict accordance with the appropriate and current requirements of the Underwriter's Laboratories, Inc. "Standard for Safety," and any others as they may be applicable. The appropriate Underwriters' Laboratories, Inc. labels shall be affixed to all lighting fixtures.
2. The Contractor is responsible for coordinating the characteristics and the appropriate U.L. labeling of all fixtures and their components with the ambient conditions which shall exist when the lighting fixtures are installed. Coordination shall include, but not be limited to, wet location labels, damp location labels, explosion proof applications, dust ignition proof applications, insulated ceilings, and other conditions which may compromise the validity of the U.L. label.

1.4 SUBMITTALS

A. Shop Drawings And Catalog Cuts

1. Prior to fabrication and submittal of shop drawings, the contractor shall check for adequate clearances, headroom and non-interference of lighting fixtures, stems and conduit entries with equipment, ducts, pipes, openings, etc.
2. Where fixtures are mounted in continuous rows, shop drawings shall indicate exact fixture location, layout, mounting locations, connecting components, coupling plates, changes in elevation, corner miter details and assembly methods.
3. Manufacturers catalog cuts will be acceptable only if they represent the fixture types exactly as specified, without any modifications in construction or electrical characteristic. Catalog cuts shall include fixture type, fixture illustration with mounting details, dimensions, materials, component description and fixture certification of suitability for use in locations indicated.
4. Catalog cuts lacking sufficient detail to indicate compliance with contract documents and compliance with the requirements noted herein will not be acceptable.
5. The Contractor shall supply photometric data, as described above and hereafter, for any fixture offered in substitution for a fixture specified for this project.
6. Photometric data test reports shall include fixture light distribution, brightness characteristics, efficiency, lamp description, lamp lumen output, and candlepower data. Lamps used for photometric report shall be identical to lamps specified; photometric reports using other lamps will not be acceptable.

B. Samples:

1. Upon request submit samples of any fixture selected by the Architect and of custom fixtures, modified fixtures and substitution items for the purpose of ascertaining photometric performance, quality of visible parts and details, maintenance features, method of installation and safety features. These samples shall be submitted for approval at no expense to the Owner, with all transportation prepaid.

1.5 QUALITY ASSURANCE

- A. Materials, equipment and appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standards as specified herein and as indicated on the Drawings. Fixture parts and components not specifically identified or indicated shall be made of materials most appropriate to their use or function and resistant to corrosion and thermal and mechanical stresses encountered in the normal application and function of the fixtures.
- B. All lamps of a given type shall be the product of one manufacturer.
- C. All ballasts for fixtures of a given type shall be product of one manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL FIXTURE DESIGN

- A. Provide thickness of sheet metal so that all fixtures are rigid, stable and will resist deflection, twisting, warping under normal installation procedures, loading, relamping, and maintenance.
 1. All luminaire housings shall be made of code gauge sheet steel, unless a heavier gauge is specified.
 2. All acrylic lenses shall be minimum 5/32" thick, unless otherwise noted.
- B. The Contractor shall coordinate and detail all necessary structural supports and support hardware required for the safe attachment of all lighting fixtures to mounting surfaces.
- C. All fixtures shall be designed for installation in the actual ventilation and temperature conditions of all installed locations.
- D. All recessed fixtures which are to be installed in insulated ceilings and any other fixtures required by code shall be provided with approved thermal protection devices to de-activate the lighting fixtures in case of excessive heat build-up.
- E. Acrylic lenses shall be provided for all fixtures in accordance with New Jersey Administrative Code, Section 5, Application of Uniform Construction Code.

2.2 FINISHES

- A. Contractor shall coordinate finish selection with Architect. Fixture finishes shall be applied in a manner that will assure a durable wear resistant surface.
- B. Metal halide fixtures shall be provided with heat and shock tempered glass enclosures capable of containment of hot quartz arc tube particles as recommended by fixture and lamp manufacturers.

2.3 LAMPS

- A. Provide all electric lamps as indicated on the lighting fixture schedule, the drawing and any applicable contract document.
- B. Lamps shall be as manufactured by General Electric, Phillips or Sylvania unless otherwise specified. All lamps of a given type shall be the product of one manufacturer.
- C. Fluorescent lamps shall be of the rapid start tri-phosphor color corrected type, CRI of 80, 3500k color, suitable for 430 ma. operation, unless indicated otherwise.
- D. Provide an additional ten percent spare lamps for all lamps specified in the lighting fixture schedule.
- E. All fluorescent and HID lamps shall be of the low-mercury content type.

2.4 WIRING

- A. All wiring shall comply with the following:
 - 1. All wiring within lighting fixtures or from the fixture to the splice with the building wiring shall be as specified under "WIRES AND CABLES".
 - 2. All fixtures shall be properly grounded as required by applicable electrical codes.

2.5 FLUORESCENT BALLASTS

- A. All fluorescent lamp ballasts shall conform to the following:
 - 1. U.L. and ANSI specifications with labels and/or symbols of approval by the U.L. and certification by C.B.M. as tested by E.T.L.
 - 2. The component parts designed, fabricated, and assembled in accordance with the latest requirements of the N.E.C., or other applicable codes.
 - 3. All ballasts shall be "Class P" indicating approved integral ballast protection. All ballasts shall be of the non-PCB type.
 - 4. Ballasts shall provide safe and reliable operation of the specified lamps.

5. Ballasts installed within each fixture type shall be identical in all respects.
6. Provide the best sound-rating available for the lamp and ballast combination, specified and clearly show their respective sound ratings. Ballasts found by the Architect to be unduly noisy shall be replaced without charge prior to acceptance of the job.
7. Relative light output (percentage of light emitted with reference tube and ballast) shall be not less than 95%.
8. Provide ballast with voltage compatible with branch circuit voltage as shown on Contract Drawings.
9. Fluorescent ballasts shall be electronic, high power factor type (90% PF, 10-20% THD, 1.7 CF, +20KHZ).
10. Ballasts shall be made as manufactured by the following manufacturers: Advance, General Electric, Magnetek or Universal.

2.6 COMPACT FLUORESCENT BALLASTS

- A. Compact fluorescent lamp ballasts shall conform to the following:
 1. Compact fluorescent lamp transformers shall be U.L. listed.
 2. Provide high power factor electronic ballast with lowest sound rating available. Refer to fluorescent characteristics above.
 3. For exterior applications provide transformers with lowest minimum starting temperature, as required.
 4. Ballasts shall be compatible with branch circuit voltage as shown on contract drawings.
 5. Ballasts shall be made as manufactured by the following manufacturers: Advance, General Electric, Magnetek or Universal.

2.7 HID BALLASTS

- A. All ballasts for metal halide HID lamps shall be UL listed, high-power-factor, Constant Wattage Auto-Transformer (CWA) type.
- B. All ballasts for high-pressure sodium HID lamps shall be UL listed, high-power factor, Lag or Auto-Regulator type.
- C. Ballasts shall be made as manufactured by the following manufacturers: Advance, General Electric, Magnetek or Universal.

2.8 LIGHTING FIXTURE SCHEDULE

- A. Refer to Contract Drawings for Lighting Fixture Schedule.

2.9 SOUND TRANSMISSION

- A. Sound transmission through lighting fixtures shall be sufficiently attenuated to maintain speech privacy. Where speech privacy is impaired due to sound leaks in the light fixture housing due to poor fabrication or use of faulty ballasts

or transformers, replace or repair lighting fixture to eliminate the sound transmission at no expense to the owner.

PART 3 - EXECUTION

3.1 DELIVERY AND HANDLING

- A. All lighting equipment delivered to the project shall be complete, including mounting devices, ballasts, sockets, transformers, wiring and any other components necessary for the proper operation and installation of the equipment. All lighting fixtures shall be assembled, wired and equipped, at place of manufacture.
- B. All lighting fixtures, when installed, shall be free of dents, warps, light leaks and any other irregularities. Blemished, damaged or unsatisfactory fixtures shall be replaced in a manner satisfactory to the Architect.

3.2 INSTALLATION

- A. Provide fixtures at locations and of types shall be as indicated on the Contract Drawings.
- B. Coordinate fixture locations with Architectural Plans, reflected ceiling plans and other reference data prior to installation.
- C. Check for adequate headroom and non-interference with other equipment, such as ducts, pipes or openings.
- D. Install each fixture properly and safely. Provide hangers, rods, mounting brackets, supports, frames, yokes, support bars and any other equipment required for a complete installation.
- E. Rigidly align continuous rows of lighting fixtures for true in-line appearance, subject to Architect's approval.
- F. Any lamps, ballasts, reflectors, lens, diffusers, side panels or other parts damaged prior to the final inspection shall be replaced at no expense to Owner.

3.3 AIMING AND ADJUSTMENT

- A. All adjustable lighting units shall be aimed, focused and locked, etc., by the Contractor under the supervision of the Architect. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, etc., required shall be furnished by the Contractor at the direction of the Architect. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely.

- B. Where possible, units shall be focused during normal working daytime hours. However, where daylight interferes with seeing and aiming, focusing shall be accomplished at night.
- C. Prior to final acceptance by the Owner, all lighting fixtures shall be thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts replaced, and all lamps operative. Replace any lamps used during construction with Architect's permission with new lamps and clean all optical elements and all visible surfaces to the Architect's satisfaction.

END OF SECTION 265000

SECTION 283100 - FIRE DETECTION AND ALARM SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

- A. Work Included: The work covered by this Section of the Specification shall include all labor, equipment, materials and services to furnish and install a complete Fire Alarm System of the addressable, non-coded type. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract. The system shall consist of, but not be limited to, the following:
1. Fire Command Station (FACP, main fire alarm control panel) and related remote panels (NAC).
 2. Remote Annunciators with enclosures.
 3. Addressable manual fire alarm stations.
 4. Addressable analog area smoke detectors.
 5. Addressable analog duct smoke detectors.
 6. Addressable analog heat detectors.
 7. Magnetic door release control.
 8. Audible notification appliances; horns.
 9. Visual notification appliances; strobes.
 10. Air handling systems shutdown control.
 11. Air handling systems re-start control from FACP.
 12. Sprinklers system supervisory switches and tamper switches supervision.
 13. Battery standby.
 14. Fire smoke damper control.
- B. Provide complete addressable fire alarm system as shown on drawings.

- C. Obtain the services of existing fire alarm service contractor (United Fire Protection – 908-688-0300) as necessary for system programming, set up, and monitoring.
- D. New system shall be fully programmed to include all devices and zone information; all signaling to existing central station shall be incorporated into new fire alarm.
- E. New and existing device and zone descriptions shall be coordinated with and approved by Owner and Architect.
- F. Related Sections:
 - 1. Section 211313 – Wet-Pipe Sprinkler Systems.
 - 2. Section 230900 – Instrumentation and Controls for HVAC.
 - 3. Section 230923 – Direct Digital Control Systems for HVAC.
 - 4. Section 230993 – Sequence of Operation for HVAC Controls.
 - 5. Section 260519 – Low-voltage Power Conductors and Cables.
 - 6. Section 260533 – Raceways and Boxes for Electrical Systems.

1.02 APPLICABLE CODES AND STANDARDS

- A. National Fire Protection Association:
 - 1. NFPA 70 – The National Electrical Code.
 - 2. NFPA 72 – National Fire Alarm Code.
 - 3. NFPA 101 – Life Safety Code.
 - 4. Local Fire Department Requirements.
- B. Underwriter’s Laboratories, Inc.
 - 1. UL 38 - Manually Activated Signaling Boxes.
 - 2. UL 217 - Smoke Detectors Single Station.
 - 3. UL 228 - Door Holders for Fire Protective Signaling Systems.
 - 4. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
 - 5. UL 268A - Smoke Detectors for Duct Applications.
 - 6. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.

7. UL 464 - Audible Signaling Appliances.
8. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
9. UL 864 - Control Units for Fire Protective Signaling Systems.
10. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
11. UL 1638 - Visual Signaling Appliances.
12. UL 1711 - Amplifiers for Fire Protective Signaling Systems.
13. UL 1971 - Standard for Signaling Devices for the Hearing Impaired

1.03 SUBMITTALS

- A. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which shall also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.
- B. Provide description of operation of the system (Sequence of Operation), similar to that provided in Part 2 of this Section of the Specifications, to include any and all exceptions, variances or substitutions listed at the time of bid. Any such exceptions, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. The sequence of operation shall be project specific, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition which may occur as part of normal or off-normal system use.
- C. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.
- D. Provide manufacturer's installation instruction manual for specified system.
- E. Provide samples of various items when requested.
- F. Provide copies of NICET Level II Fire Alarm certifications for the two (2) technicians assigned to this project.
- G. Provide shop drawings as follows:
 1. Coversheet with project name, address and drawing index.

2. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.
3. Device riser diagram which individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address which shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those require on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
4. Control panel termination drawing(s). Shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data gathering panel, a separate control panel drawing shall be provided, which clearly indicates the designation, service and location of the control enclosure. End-of-line resistors (and values) shall be depicted.
5. See section 3.4 DOCUMENTATION AND TRAINING for other documents relating to this section.
6. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors (and values) shall be depicted.
7. Device layout floor plans shall be created for every area served by the fire alarm system. CAD Files (AutoCAD MEP 2013) shall be provided by the consulting engineer for the use of the fire alarm system equipment vendor in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8 INCH SCALE. All addressable devices shall be depicted with a discrete address which corresponds with that indicated on the Riser Diagram. All notification appliances shall also be provided with a circuit address which corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to

accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.

8. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes. The initial submission shall be Revision 0, with Revision A, B, or C as project modifications require.
- H. Battery calculations shall be provided on a per power supply/charger basis. These calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. Failure to provide these calculations shall be grounds for the complete rejection of the submittal package.
- I. Table of contents, product data sheets, sequences of operation, battery calculations, installation instructions, licenses, NICET certifications and B-Size (blackline) reduced shop drawings shall be provided by the fire alarm vendor as part of a single, spiral bound submittal book. The submittal book shall have laminated covers indicating the project address, system type, and Contractor name and information. The book shall consist of labeled dividers, and shall not exceed 9 1/2" in width, and 11 1/2" in height. No less than eight (8) sets of submittal booklets shall be provided to the Engineer for review and comment. Additional copies may be required at no additional cost to the project.
- J. Scale drawing sets shall be submitted along with the submittal booklets. These drawings may be either D-Size or E-Size drawings and of a sufficient resolution to be completely read. Sets shall be bound and folded so as to not take up more than 100 square inches of space. No less than eight (8) sets of scale drawing sets shall be provided to the Engineer for review and comment. Additional copies may be required at no additional cost to the project.
- K. Submit letter of approval for installation before requesting acceptance of system.

1.04 WARRANTY

- A. Manufacturer shall guarantee the system equipment for a period of Two (2) years from date of final acceptance of the system.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Subject to the requirements of the Specifications, the following manufacturers offer products that may be incorporated into the project:
 - 1. Notifier – Campus standard.
 - 2. Approved Equal.
- B. The Fire Alarm System Manufacturer shall document, by UL Listing where appropriate, that all components of the system (new and existing notification appliances, auxiliary relays, etc.) are compatible with the fire alarm panel. Further, the manufacturer shall be the single point of responsibility for all components provided and shall assume all warranty responsibility for said components.

2.02 CIRCUITING GUIDELINES

- A. Each Signaling Line Circuit (SLC) shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices.
- B. Where it is necessary to interface conventional initiating devices, provide intelligent input modules to supervise Class B zone wiring.
- C. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:
 - 1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.
 - 2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When an odd number of devices exist at a single location, provide additional single input addressable modules.
- D. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:
 - 1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without

- the need for additional control components (power supplies, signal circuit modules, amplifiers, batteries, etc.)
2. Visual Signals: Provide sufficient spare capacity to assure that the addition of three (3) audible devices can be supported without the need for additional control components (power supplies, signal circuit modules, batteries, etc.)
- E. Each of the following types of remote equipment associated with the fire alarm system shall be provided with a form 'C' control relay contact as shown on the drawings, but shall be typically as follows:
1. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
 2. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.
 3. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.
- F. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

2.03 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

- A. The system shall identify any off normal condition and log each condition into the system database as an event.
1. The system shall automatically display on the control panel Liquid Crystal Display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.
 2. The system shall have a Queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color coded indicator for each type of event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
 3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.

4. The user shall be able to review each event by simply selecting scrolling keys (up-down) for each event type.
 5. New alarm, supervisory, or trouble events shall sound a silencing audible signal at the control panel.
- B. Operation of any alarm initiating device (manual station, duct smoke detector, area smoke detector, sprinkler water flow) shall automatically:
1. Update the control/display as described above (A.1.)
 2. Sound all audible appliances throughout the building.
 3. Activate all strobe appliances throughout the building. All strobe appliances shall be synchronized with each other. Visual devices shall be non-silenced unless the system is successfully reset.
 4. Operate control relay contacts to shutdown all HVAC units in the building.
- C. Activation of a sprinkler supervisory initiating device shall:
1. Update the control/display as described above (B.1.)
 2. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.
- D. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring shall automatically:
1. Update the control/display as described above (A.1.)
 2. Visually and audibly annunciate a general trouble condition on the remote annunciator panels. The visual indication shall remain on until the trouble condition is repaired.
- E. System Reset
1. Upon clearing all alarm conditions, the panel reset button shall be operated. The panel shall reset and indicate a normal condition.
 2. A key switch shall be provided, which when operated, shall allow the HVAC fans, which were shutdown by the Fire Alarm System, to restart. See the Sequence of Operation in the Section 23 09 93 for additional information.

2.04 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

- A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.
- B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
- C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.
- D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.
- E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.
- F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.
- G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels. The use of 'canned' smoke, when used in accordance with manufacturer, NFPA 72 and local Code requirements, is an acceptable method for simulating smoke detector levels.
- H. Allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.
- I. THE END-USER SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SOFTWARE RUNNING IN THE SYSTEM AT ALL TIMES. The fire alarm

equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the time of final system acceptance. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database. The extent of hardcopy database documentation to be provided shall be defined by the Consulting Engineer prior to final system acceptance.

2.05 Fire Alarm System Equipment

A. Fire Command Station (Fire Alarm Control Panel):

1. The fire alarm control panel or panels and all system devices (horn-strobes, strobes, pull stations, smoke and heat detectors, etc. shall be UL Listed and Approved for the use of fire alarm systems. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.

B. System Controllers:

1. The main controller CPU shall be supervised, site programmable, and of modular design supporting up to 100 detectors and 100 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2,000 Intelligent Addressable points. The system shall be designed with peer-to-peer networking capability for enhanced survivability, with support for up to 64 nodes, each with up to 2000 points and an overall capacity of 128,000 points. The cabinets shall be steel.
2. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.
3. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 168 character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays. Remote LCD annunciators shall also display each and every point in the system and be sized with the same number of characters as in the main FACP display.

- C. The system shall be programmed to address and map all system devices attached to the main controller. A minimum default single stage alarm system operation shall be supported with alarm silence, event silence, drill, lamp test, and reset common controls.
- D. Advanced Windows-based System Definition Utility with Program Version Reporting to document any and all changes made during system start-up or system commissioning shall be used to maintain site specific programming. Time and Date Stamps of all modifications made to the program must be included to allow full retention of all previous program version data. It shall support programming of any input point to any output point. The system shall support the use of Bar Code readers to assist custom programming functions. It shall allow authorized customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms. The system program shall meet the requirements of this project, current codes and standards, and satisfy the local Authority Having Jurisdiction.
- E. The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, normal/alarm LEDs, relay bases, sounder bases and isolator bases.
- F. The system shall use full digital communications to supervise all addressable loop devices for placement, *correct location*, and operation. It shall initiate and maintain a trouble if a device is added to a loop.
- G. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.
- H. System circuits shall be configured as follows: Addressable analog SLC loops Class A (Style 7); Initiating Device Circuits Class B; Notification Appliance Circuits Class B; Network Communications Class A; Annunciator Communications Class B. Provide a return path (loop) at least 10 feet from the main.
- I. Single stage operation shall be provided.
- J. The system shall have a UL Listed Detector Sensitivity test feature, which shall be a function of the smoke detectors and performed automatically every 4 hours.
- K. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases.

- L. All panel modules shall be supervised for placement and return trouble if damaged or removed.
- M. The system shall have a CPU watchdog circuit to initiate trouble should the CPU fail.
- N. Audible notification appliances shall be affected by signal silence features. Visual signal appliance shall not be affected by signal silence features.
- O. User Interface: The Display Module shall be of membrane style construction with a 8 line by 21 character Liquid Crystal Display. The LCD shall use super-twist technology and backlighting for high contrast visual clarity. In the normal mode display the time, the total number of active events and the total number of disable points. In the alarm mode display the total number of events and the type of event on display. Reserve 40 or more characters of display space for user custom messages. The module shall have visual indicators for the following common control functions; AC Power, alarm, supervisory, monitor, trouble, disable, ground fault, CPU fail, and test. There shall be common control keys and visual indicators for; reset, alarm silence, panel silence, and drill. Provide four pairs of display control keys for selection of event display by type (alarm, supervisory, monitor and trouble) and forward / backward scrolling through event listings. The operation of these keys shall be integrated with the related common control indicators to flash the indicators when undisplayed events are available for display and turn on steady when all events have been displayed. Allow the first event of the highest priority to capture the LCD for display so that arriving fire fighters can view the first alarm event "hands free". Provide system function keys; status, reports, enable, disable, activate, restore, program, and test. The module shall have a numeric keypad, zero through nine with delete and enter keys.
- P. Power Supplies: The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 45 minutes.
- Q. Auxiliary power supplies shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal

power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 5 minutes.

- R. Network alphanumeric annunciator shall be located as indicated on the plans and in the fire safety director's office or constantly attended location. The annunciator shall contain a supervised, back lit, liquid crystal with a minimum of 8 line with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features:

1. Matched appearance with other system displays:
 - a. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system:
 - 1) Alarm
 - 2) Supervisory
 - 3) Trouble
 - 4) Monitor

- S. The annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area. The annunciators shall be mounted in stand-alone enclosures.

2.06 COMPONENTS

- A. Intelligent Devices—General:

1. Each remote device shall support its functionality and service-ability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.

2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location as required by UL and NFPA Standards.

B. Intelligent Detectors—General:

1. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
2. Each detector shall have an integral electronic device capable of making alarm decisions based on fire parameter information stored in the detector head or the control panel to which the device is connected. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds.
3. Each detector shall have a separate means of displaying communication and alarm status. An LED shall flash to confirm communication with the analog loop controller. An LED shall be steady on to indicate alarm status. Alternate LED displays shall be acceptable.
4. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance.
5. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.
6. Each detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact

of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long term and 4 hour short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.

7. The intelligent analog detectors shall be suitable for mounting on a common detector mounting base.
8. The Fire alarm system shall have the ability to set elevator lobby Ionization or Multi Sensing smoke detectors for alarm verification. Detector in the alarm verification mode shall indicate, by point in a text format at the main control and at the remote LCD annunciators.

C. Fixed Temperature/Rate of Rise Heat Detector

1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral electronic device shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 degrees F (57 degrees C) and a rate-of-rise alarm point of 15 degrees F (9degrees C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

D. Photoelectric Smoke Detector

1. Provide intelligent photoelectric smoke detectors. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually

monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications.

2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:
 - a. Temperature: 32 to 120 degrees F (0 to 49 degrees C)
 - b. Humidity: 0-93% RH, non-condensing
 - c. Elevation: no limit

E. Standard Detector Mounting Bases

1. Provide standard detector mounting bases suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall have the following minimum requirements:
 - a. Removal of the respective detector shall not affect communications with other detectors.
 - b. The base shall be capable of supporting one (1) Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

F. Duct Detector Housing

1. Provide smoke detector duct housing assemblies to facilitate mounting an intelligent analog Photoelectric Detector along with a standard detector mounting base. Provide for variations in duct air velocity between 300 and 4000 feet per minute. Protect the measuring chamber from damage and insects. Provide an air exhaust tube and an air sampling inlet tube which extends into the duct air stream up to ten feet. Provide drilling templates and gaskets to facilitate locating and mounting the housing. Finish the housing in baked red enamel. Provide Remote Alarm LED Indicators and test station for each duct detector.

G. Intelligent Modules—General

1. Intelligent modules shall be individually addressable devices, utilized for monitoring and/or controlling devices or equipment. The personality of multifunction modules shall be programmable at

site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. An LED shall flash to confirm communication with the loop controller and shall be steady on to indicate an alarm condition. Alternate LED displays shall be acceptable. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

- a. Temperature: 32 to 120 degrees F (0 to 49 degrees C)
- b. Humidity: 0-93% RH, non-condensing

H. Single Input Module

- 1. Provide intelligent single input modules. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:
 - a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 - b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches)

I. Dual Input Module

- 1. Provide intelligent dual input modules. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types:

- a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 - b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches)
- J. Waterflow/Tamper Module: Provide intelligent water flow/tamper modules. The Water flow/Tamper Module shall be factory set to support two (2) supervised Class B input circuits. Channel A shall support a Normally-Open Alarm Delayed Latching Waterflow Switch circuit. Channel B shall support a Normally-Open Active Latching Tamper Switch. The waterflow/tamper module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square box with 1-gang covers.
- K. Control Relay Module

Provide intelligent control relay modules. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
- L. Intelligent Manual Pull Stations—General
 - 1. It shall be possible to address each fire alarm pull station. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment:
 - a. Temperature: 32 to 120 degrees F (0 to 49 degrees C)
 - b. Humidity: 0-93% RH, non-condensing

M. Manual Pull Station

1. Provide intelligent single action, single stage fire alarm stations. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering. The manual station shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

N. Notification Appliances – General

1. All appliances shall be UL Listed for Fire Protective Service.
2. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act accessibility guidelines and shall be UL 1971 Listed.
3. All appliances shall be of the same manufacturer as the Fire Command Station specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
4. Any appliances which do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.

O. Strobes

1. Provide strobes. Screw terminals shall be provided for wiring. The strobes shall have a red face plate. They shall provide 75 cd (75 cd per UL1971) synchronized flash outputs. Strobes shall mount in a North American 4" square box. The strobe shall have lens markings oriented for wall mounting.

P. Remote Relays:

1. Multi-Voltage Control Relays:
 - a. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a

voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

2. Multi-Voltage Control Relays:

- a. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagram. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the local Fire Department and specified with in.
- B. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.
- C. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.
- D. All manual pull stations shall be mounted 48 inches above the finished floor, as measured on handle.
- E. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured on center. Devices shall be mounted no less than 6 inches from the ceiling.
- F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

- G. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72 for such devices.
- H. All mechanical rooms, boiler rooms, wiring closets or areas with no hung ceilings shall be piped with 3/4" conduit. All device plenum rated wiring shall be mechanically protected with conduit. All areas in public view shall be in metal conduit. All boxes must be painted red and labeled "INTERIOR FIRE ALARM".
- I. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.
- J. All low voltage wiring terminated to the fire alarm system shall be PLENUM RATED with no exceptions and no less than No. 12 AWG in size for NAC circuits and 16 AWG for Initiating Circuits, and solid copper.
- K. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding.
- L. All wiring shall be color-coded throughout, to National Electrical Code standards.
- M. Power-limited/Non-power-limited NEC wiring standards shall be observed.
- N. All junction box covers shall be painted red and labeled INTERIOR FIRE ALARM SYSTEM.
- O. Fire alarm system wiring shall not co-mingle with any other system wiring in the facility. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system shall co-habitation be permitted (i.e. at fan starters or elevator controllers). This shall be field reviewed by the project engineer.
- P. Fire alarm control panel enclosures shall have engraved labels indicating, "INTERIOR FIRE ALARM SYSTEM", and the areas of the building served by that panel.
- Q. Auxiliary relays shall be appropriately labeled to indicate "FIRE ALARM SYSTEM" and their specific function (i.e. FAN SHUTDOWN).
- R. All fire alarm wiring shall be continuous and unspliced. Terminations shall only occur at fire alarm devices or control panel enclosures under

terminal screws. All other splicing methods are specifically disallowed.(i.e. plastic wirenuts).

- S. All fire alarm wiring shall be installed using a dedicated system of conduits.
- T. All fire alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1" min.) with bushings, and fire stopped in accordance with the Building Code and AHJ requirements.
- U. The system shall be arranged to receive power from one three wire 120 Vac, 20 A supply. All low voltage operation shall be provided from the fire alarm control panel.
- V. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the Contractor to bring it, in writing, to the attention of the Architect. Failure to bring such issues to the attention of the Architect shall be the exclusive liability of the installing Contractor.

3.02 FIELD QUALITY CONTROL

- A. The system shall be installed and fully tested under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all of the function as specified.
- B. The installing contractor or fire alarm equipment vendor shall have no less than two (2) NICET Level II fire alarm technicians dedicated to this project.
- C. The Installing Contractor and the Fire Alarm System Vendor shall, upon the request of the Architect or End-User, attend any and all project meetings for the purpose of accurately determining progress.
- D. It shall be the responsibility of the installing contractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Architect, End-User or AHJ, the installing contractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

3.03 TESTS

- A. The fire alarm system vendor shall test the system in accordance with the manufacturer's requirements and NFPA 72. The vendor shall provide completed reports to the Architect for review prior to final acceptance.

3.04 DOCUMENTATION AND TRAINING

- A. The contractor shall compile and provide complete manuals on the completed system to include SITE SPECIFIC operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams and a manufacturer's suggested spare parts list.
- B. In addition to the above manuals, the Electrical Contractor shall provide the services of the manufacturer's trained representative for two (2) separate calendar days for a period of four (4) hours per day to instruct the owners' designated personnel on the operation and maintenance of the entire system.
- C. As-built drawings shall consist of the following:
 - 1. Complete revision of all previously submitted drawings
 - 2. Point-to-point depiction of all device wiring on the device layout floor plans.
 - 3. One (1) set of B-size, laminated as-built drawings.
 - 4. Two (2) sets of 30"x42"inch 1\16"=1' scale drawing showing all points of fire alarm, intrusion alarm, card access and CCTV locations. One set shall be submitted with close-out documents. Second set shall be mounted in frame with a lexan cover at a location designated by the Owner. These drawing must be submitted to project Engineer for approval.
- D. Turnover of all software database hard/soft copies shall be required prior to project close-out. This shall include all possible software logs, diskettes containing exported project files, hard copies of all device maps, the revision number of the version used, and all required passwords. The turnover of all database information shall occur prior to End-User training.

END OF SECTION

SECTION 321400

UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete pavers set in aggregate and bituminous setting beds.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For pavers, including test data for freeze-thaw resistance.
- B. Shop Drawings: Include plans and details of unit paving in relation to other work.
 - 1. Show locations and details of joints within paving and between paving and other materials. Show perimeter edging and restraint conditions.
- C. Samples for Selection: For metal edge restraints.
- D. Samples for Verification: 6-inch square Samples of paver units demonstrating color range.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For aggregate setting bed and bituminous setting bed materials.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who employs experienced mechanics who are skilled in installing unit pavers similar in material, design, and extent to those indicated for this Project and whose projects have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Store asphalt cement and other bituminous materials in tightly closed containers.

1.7 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Bituminous Setting Bed:
 - 1. Install bituminous setting bed only when ambient temperature is above 40 degrees F and when base is dry.
 - 2. Apply asphalt adhesive only when ambient temperature is above 50 degrees F and when temperature has not been below 35 degrees F for 12 hours immediately before application. Do not apply when setting bed is wet or contains excess moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CONCRETE PAVERS

- A. Concrete Pavers: Solid paving units made from normal-weight concrete with a compressive strength not less than 8000 psi; water absorption not more than 5 percent according to ASTM C 140; 155 pounds per cubic feet density; and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
 - 1. Basis of Design: "Prest Pavers"; Hanover Architectural Products.
 - a. Comparable Manufacturers: Subject to compliance with requirements, comparable products of the following manufacturers may be considered:
 - 1) Sunny Brook Pressed Concrete Company.
 - 2) Wausau Tile.

2. Thickness: 2 inches.
3. Nominal Face Size: 36-inch by 18-inch.
4. Color: Limestone Gray.
5. Finish: No. 13 Tudor Finish.

2.3 CURBS AND EDGE RESTRAINTS

- A. Steel Edge Restraints: Manufacturer's standard painted steel edging 1/4 inch thick by 5 inches high with loops pressed from or welded to face to receive stakes at 36 inches on center and steel stakes 15 inches long for each loop.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Border Concepts, Inc.
 - b. Collier Metal Specialties, Inc.
 - c. J. D. Russell Company (The).
 - d. Sure-loc Edging Corporation.
 2. Color: As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

- A. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.5 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 57.
- B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
- D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
 1. Provide sand of color needed to produce required joint color.
- E. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.

4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

- F. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.6 BITUMINOUS SETTING-BED MATERIALS

- A. Primer for Base: ASTM D 2028/D 2028M, cutback asphalt, grade as recommended by unit paver manufacturer.
- B. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.
- C. Asphalt Cement: ASTM D 3381/D 3381M, Viscosity Grade AC-10 or Grade AC-20.
- D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
1. Provide sand of color needed to produce required joint color.

2.7 BITUMINOUS SETTING-BED MIX

- A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to 300 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

- B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- C. Proof-roll prepared subgrade according to requirements in Section 31 20 00 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Joint Pattern: As indicated on Drawings.
- E. Tolerances: Do not exceed **1/32-inch** unit-to-unit offset from flush (lippage) or **1/8 inch in 10 feet** from level, or indicated slope, for finished surface of paving.
- F. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints, unless otherwise indicated. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 07 92 00 "Joint Sealants."
- G. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.
- H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 - 2. For metal edge restraints with top edge exposed, drive stakes at least **1 inch** below top edge.

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, and replace with compacted backfill or fill as directed.

- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least **24 inches**.
- D. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- E. Place leveling course and screed to a thickness of **1 to 1-1/2 inches**, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- F. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- G. Set pavers with a minimum joint width of **1/16 inch** and a maximum of **1/8 inch**, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- H. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a **3500- to 5000-lbf** compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
 - 1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least **36 inches** of uncompacted pavers adjacent to temporary edges.
 - 2. Before ending each day's work, compact installed concrete pavers except for **36-inch** width of uncompacted pavers adjacent to temporary edges (laying faces).
 - 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within **36 inches** of laying face.
 - 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- I. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- J. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- K. Repeat joint-filling process 30 days later.

3.5 BITUMINOUS SETTING-BED APPLICATIONS

- A. Apply primer to concrete slab or binder course immediately before placing setting bed.
- B. Prepare for setting-bed placement by locating **3/4-inch** deep control bars approximately **11 feet** apart and parallel to one another, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.

- C. Place bituminous setting bed where indicated, in panels, by spreading bituminous material between control bars. Spread mix at a minimum temperature of 250 degrees F. Strike setting bed smooth, firm, even, and not less than 3/4 inch thick. Add fresh bituminous material to low, porous spots after each pass of striking board. After each panel is completed, advance first control bar to next position in readiness for striking adjacent panels. Carefully fill depressions that remain after removing depth-control bars.
- D. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers. If additional leveling of paving is required, and before treating joints, roll paving with power roller after sufficient heat has built up in the surface from several days of hot weather.
- E. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

3.6 REPAIR

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 32 14 00

