PROJECT MANUAL

Riverton Expansion and Renovation Project
City of Portland

LOCATION:
1600 Forest Avenue
Portland, Maine

May 9, 2006

Owner:
City of Portland
389 Congress Street
Portland, ME 04101
(207) 874-8654 Phone
(207) 874-8652 Fax

Architect:
Semple & Drane Architects
496 Congress Street
Portland, Maine 04101
(207) 761-4231 Phone
(207) 774-0152 Fax

Civil Engineer:
Pinkham & Greer Consulting Engineers
170 US Rte 1
Falmouth, Maine 04105
(207) 781-5242 Phone
(207) 781-4245 Fax

Mechanical, Electrical, Plumbing, Engineering and Technology:
Allied Engineering
160 Veranda St
Portland, Maine 04103
207-221-2260 Phone
207-221-2266 Fax

TABLE OF CONTENTS

FORMS AND CONTRACT REQUIREMENTS

CONSTRUCTION SPECIFICATIONS

SECTION 00020

INVITATION TO BID

Sealed Bids for:

Riverton Expansion and Renovation Project
1600 Forest Avenue
Portland, Maine
Bid Number #7706

in accordance with Bidding and Contract Documents prepared by:

Semple & Drane Architects
496 Congress St., 4th Floor
Portland, ME 04101
(207) 761-4231

hereinafter called the Architect, will be received by:

City Of Portland
Purchasing Office, City Hall, Room 103
389 Congress Street
Portland, Maine 04101

Attn. **Matthew F. Fitzgerald, Purchasing Agent**
(207) 874-8654

hereinafter called the "City", or "Owner" at the address listed above.

Sealed Bids for the above project, clearly marked on the outside envelope with the name of the bidder, project, title, and bid number, shall be received by the City at the address listed above, no later than the times and dates specified below, at which times and place they will be publicly opened and forthwith read aloud. Any bid received after the time and date specified will not be considered.

Bids: **3:00 p.m.**, eastern daylight savings time, **Thursday, June 1, 2006**

A bid deposit in the amount of five percent (5%) of the Bid amount, as applicable, shall be submitted with each Bid. Bid deposit shall be in the form of cash or a certified check, or a Treasurer's or Cashier's check issued by a responsible bank or trust company payable to the **City**, or a bid bond (a) in a form satisfactory to the Awarding Authority, (b) with a surety company qualified to do business in the State of Maine, and (c) conditioned upon faithful performance by the principal of the agreements contained in the Bid. Return of bid deposits will be in accordance with the provisions of the City's Procurement Ordinance.

The successful Bidder will be required to furnish Performance Bond and Payment Bond, each in the amount of 100% of the Contract Amount. The cost of such bonds shall be included in the bid price. Such bonds shall be of a surety company qualified to do business under the laws of the State of Maine.

All questions shall be directed in writing only, to the Purchasing Office at the above address and be **received by 3:00 p.m., Wednesday, May 24, 2006**. These may be faxed to 207-874-8652, e-mailed to mff@portlandmaine.gov or hand delivered to the Purchasing Office. Questions received after this time will not be addressed. Responses from the City that substantially alter this bid will be issued in the form of a written addendum to all bid holders registered in the Purchasing Office. Oral explanations or interpretations given before the award of the contract will not be binding.

All proposals shall be submitted on the attached form and are to remain open for sixty (60) days after their opening.

Late bids, unsigned bids, bids without the required surety and/or facsimile bids will not be accepted.

The successful proposer shall agree to defend, indemnify and save the City harmless from all losses, costs or damages caused by its acts or those of its agents, and, before signing the contract, will produce evidence satisfactory to the City's Corporation Counsel of coverage for General Public and Automobile Liability insurance in amounts not less than $500,000 per person, $5,000,000 per occurrence for bodily injury, death and property damage, protecting the contractor and the City, and naming the City as an additional insured from such claims, and Workers' Compensation insurance. The City disclaims any and all responsibility for injury to contractors, their agents or others while examining the job or at any other time.

Copies of Contract Documents may be obtained by each Bidder from the City Purchasing Office, Portland City Hall, 389 Congress Street, Room 103, Portland, ME, between the hours of 8:00 AM and 4:30 PM Monday through Friday, on non-refundable payment of cash or check for **$200.00** per set, payable to the **City of Portland**. A fee of $25.00 shall be added to each set where shipping is requested.

Bidding and Contract Documents may be examined during regular office hours at the Owner's Office, the Architects Office and:

Central Office
Portland Public Schools
196 Allen Avenue
Portland, ME 04103

A mandatory pre-bid conference will be held at **3:30 p.m.**, local time, on **Thursday, May 18, 2006** at the site, **Riverton Elementary School, 1600 Forest Avenue, Portland, ME.** Following the pre-bid conference there will be a tour of the site with the Architect. Only those General Contracting firms represented at this meeting may bid on the project. All other filed sub-bidders, subcontractors and suppliers are also invited to attend.

Any inconsistency between the Invitation to Bid, Information for Bidders, Bid Forms, Conditions of the Contract, and any other Contract Documents and these statutes, or any other applicable statutes, bylaws, or regulations existing on the date on which the bids are to be received, shall not be grounds for invalidating the bidding procedures, but, where required by law, such statute, bylaw, or regulation shall be deemed to govern.

Prior to any payment by the City, the contractor may be required to supply the City with a Waiver of Lien -- Material and Labor for the total awarded contract cost, guaranteeing payment in full for all labor and materials used or required in connection with the work described in this bid. The City will also require waivers of lien, signed by individual subcontractors, with requests for progress payments.

Any mechanic's lien or any other lien which may be filed against the premises which are the subject of the contract by reason of the work described herein shall be defended (by counsel reasonably acceptable to the City) and promptly discharged by the Contractor at its own expense. If the Contractor should fail either to defend the City against the lien or to discharge it, then the City may do so at the Contractor's expense. In the event of such an undertaking by the City, the Contractor will promptly reimburse the City for all its costs and expenses in so doing including, but not limited to, reimbursement of the City's reasonable counsel fees and costs which may be incurred by it in substituting a bond in place of the lien.

The Assistant City Manager, or their designee, shall be the City contact person during the course of the work. The contractor shall furnish all labor, materials, fixtures, supplies, equipment and transportation necessary to do the work as specified. Work shall be conducted in an orderly manner and all work shall be performed in accordance with best trade policy and in conformance with pertinent O.S.H.A., Local, State and Federal Government regulations.

The contractor shall assume all risk and bear any loss or injury to property or persons occasioned by neglect or accident during the progress of work until the same shall have been completed and accepted. The contractor shall also assume all blame or loss by reason of neglect or violation of any state or federal law or municipal rule, regulation or order.

The contractor shall give to the proper authorities all required notices relating to the work, obtain all official permits and licenses, and pay all proper fees (fees for any City permits pertaining to this project will be waived) if applicable (including dump disposal fees if applicable). The contractor shall make good any injury that may have occurred to any adjoining building, structure or utility in consequence of this work. The Assistant City Manager, or her designee, shall be the City contact person during the course of the work.

Materials and equipment purchased for permanent installation in this project are exempt from the State of Maine Sales and Use tax and from all Federal Excise taxes. Each bidder shall take this exception into account in calculating his bid price for the work.

The contractor shall erect, and maintain at all times, any and all safeguards necessary for the protection of life and property of the general public, the contractor's work force and of all pedestrian and vehicular traffic, as may be applicable and/or has been indicated.

The contractor shall keep accurate records of all services performed under the agreement and shall submit such information to the Architect monthly for work that is completed. Payment for such services shall be made to contractor not more than thirty (30) days after receipt of said forms and acceptance of the work by the Architect. Progress payments will be made, less a 10% retainage, which will be held until release is authorized by the Architect upon final inspection and acceptance of the work.

Pursuant to Portland City Code, the City reserves the right to cancel any contract immediately for cause, or for convenience on thirty days prior written notice to the contracted firm.

The City of Portland, Maine, reserves the right to waive any informalities in bids, to accept any bid and to reject any and all bids should it be deemed for the best interest of the City to do so. The City reserves the right to substantiate Proposer's qualifications, capability to perform, availability, past performance record and to verify that bidders are current in their obligations to the City.

Matthew F. Fitzgerald
Purchasing Agent

END OF DOCUMENT

SECTION 00110

INSTRUCTIONS TO BIDDERS

Please note the following disclosure: This is a City of Portland, Maine bid document with deviates from the standard State of Maine bid documents.

1.00 COMPLEMENTARY DOCUMENT

A. Document 00020, INVITATION TO BID, included herewith, is complementary to this document and shall be carefully reviewed by bidders for specific instructions which are not repeated herein.

2.00 STATUTES REGULATING COMPETITIVE BIDDING

A. Bidding procedures and award of general contract shall be in accordance with the provisions of the City Procurement Ordinance and the General Laws of the State of Maine, including all current amendments.

B. In the event of any discrepancy or inconsistency between the provisions of these Bid and Contract Documents and the above-mentioned statutes, the provisions of the above-mentioned statutes shall govern. In such event, the application of all remaining provisions not in conflict to any circumstance other than that in which the conflict occurs shall not be affected thereby.

3.00 BIDDER'S QUALIFICATIONS

A. **THE BIDDERS WILL NEED TO PROVIDE AN EXPERIENCE STATEMENT AND A LIST OF SIMILAR PROJECTS AND CURRENT ONGOING PROJECTS.**

4.00 INTERPRETATION OF DOCUMENTS: NOTIFICATION OF ERRORS

A. Interpretation of the provisions of the Bid and Contract Documents will be made by the City of Portland upon written request of any bidder, provided that the City receives such request by **3:00 p.m., Wednesday, May 24, 2006**, and that the City considers such interpretation to be of sufficient importance. Oral or telephone interpretations will not generally be made, and if made, shall be strictly informal and not legally valid or binding.

B. Such written interpretations shall be in the form of Addenda to the Bid and Contract Documents.

C. Bidders are urged to communicate all errors and discrepancies found in the Bid and Contract Documents to the City of Portland. Telephone calls pointing out any such errors or discrepancies will be taken by the City, but only for the purpose of receiving the information in order that it may be properly processed, and not for interpretation or clarification.

5.00 EXAMINATION OF BIDDING AND CONTRACT DOCUMENTS

A. Each Bidder shall carefully examine the Bid and Contract Documents to obtain a thorough understanding of the work of his bid in addition to work of related trades. In addition, each Bidder shall personally visit the site to thoroughly acquaint himself with the conditions as they exist thereon.

B. Failure of any Bidder to thoroughly examine the Bid and Contract Documents or to visit and examine the site shall in no way relieve him of any obligation with respect to his bid or of any responsibility assigned him under the Contract.

6.00 PRE-BID CONFERENCE

A. A mandatory Pre-bid conference will be held at location and time stipulated in the Invitation to Bid.

7.00 MODIFICATION AND WITHDRAWAL OF BIDS

A. Modifications or withdrawals of Bids will be permitted after submission of such bids provided clearly written, readily understandable instructions for same are received by the City in writing prior to time established for opening of such bids. No Bid may be withdrawn after that time.

8.00 ADDENDA

A. Addenda may be required during the bidding period to modify, clarify, or interpret the Bid and Contract Documents. It is intended, but not guaranteed, that such Addenda shall be mailed or faxed by the City to all persons or parties to whom Bid and Contract Documents have been issued (Bidders of Record). Failure to receive such Addenda shall in no way relieve any bidder from the execution of its provisions. All bidders are cautioned to verify the number of Addenda which have been issued (this can be done on our website, www.portlandpurchasing.com) and to secure any needed copies from the City Purchasing Office before submitting a bid.

9.00 FORM FOR BIDS

A. The City will make available to every person applying therefore, a Form for Bid. Each bona fide Bidder will be furnished forms for his proposal upon request. Such forms will be made available at the City's office during regular office hours throughout the bidding period. Bids must be submitted on the forms provided by City or on forms included in the bid documents of the Project Manual.

B. All blank spaces provided on the bid forms shall be filled in with ink or typewriter. Where space is provided, sums shall be expressed in both words and figures. In case of discrepancy between the two, the written words shall govern.

C. No interlineations, additions, alterations, or erasures shall be made on the forms.

10.00 ALTERNATES

A. Each Bidder shall bid on all alternates listed. In the event that any alternate does not involve a change in the amount of the bid, the bidder shall so indicate by using the words, "No Change", in the space provided for that alternate.

B. Bidders shall enter on the Form for Bid a single amount for each alternate, such amount to consist of the total of all the amounts for the given alternate plus the amount for work of the alternate to be performed by the General Contractor.

C. The low bidder will be determined on the basis of the sum of the Base Bid; any alternates accepted will be assessed on a separate and individual basis.

11.00 SUBMISSION OF BIDS

A. The Bid Form shall be properly executed and enclosed with the required bid deposit in a sealed envelope plainly marked on the outside with the information stated in Document 00020, Invitation to Bid.

B. If Bids are mailed, the above required envelope shall be enclosed in a second envelope identified with the above markings and mailed to the place of bid opening, as described in the Invitation to Bid. Mailed Bids must be received before time scheduled for opening of Bids.

12.00 PERFORMANCE AND PAYMENT BONDS

A. The Performance and Payment Bonds required of the Contractor shall each be in the amount of 100% of the Contract Sum from a surety company qualified to do business under the laws of the State of Maine and approved by the City.

13.00 AWARD OF CONTRACT

A. The Contract will be awarded to the lowest responsible and responsive bidder. The Contract award is contingent upon the City of Portland receiving all associated permits from the Maine Department of Environmental Protection.

14.00 COMMENCEMENT AND COMPLETION OF WORK

A. The successful bidder, upon execution of the Contract Agreement, shall commence the work of the Contract within seven (7) calendar days from receipt of written Notice to Proceed issued by the Awarding Authority within fourteen (14) calendar days after said execution of the Contract Agreement, and shall thereafter diligently and continuously carry on the work in such manner as to substantially complete the work within the number of calendar days proposed by the bidder.

15.00 DEFINITION OF TERMS: For this project, the following definitions shall apply:

A. Calendar Day - Every day shown on the calendar.

B. Amount of the Awarded Contract - The total lump sum set forth in the proposal by the bidder.

C. Daily Cost - The amount which represents the average daily cost of interference and inconvenience to the user and the daily cost to the City.

D. Substantially complete - The work will be considered substantially complete when it has received approval for occupancy by the City of Portland, the Architect, and is ready for beneficial use by the Portland School Department.

16.00 DELAY REMEDY

A. Notwithstanding any other provision of this Contract to the contrary, the Contractor hereby agrees that neither the Contractor nor anyone else performing work under this Contract shall have any claim against either the Owner or the Architect for damages of any kind of account of delay in the commencement of the work, delay or suspension of the work or any portion thereof, or any acceleration following such delay or suspension, whether such delay should be caused by the Owner or Architect or result from any other cause. The sole remedy for any such delay, suspension or acceleration will be an extension of time, as provided in the Contract Documents. The Contractor, further, agrees that the delays which are addressed in this article include, but are not limited to, both changes in project funding as well as changes in governmental or administrative regulations affecting the Project, except changes in such regulations which are promulgated by the Owner.

17.00 EQUAL EMPLOYMENT AND AFFIRMATIVE ACTION

A. The Awarding Authority is an equal opportunity employer and has an active affirmative action employment plan. The Contractor shall have an Affirmative Action Plan and shall upon request submit it to Owner's Attorney for approval before execution of the Agreement for the Project.

AIA Document A312

Performance Bond

Bond No. : 08299162

Conforms with the American Institute of Architects, AIA Document A312.
Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):
LANGFORD & LOW, INC.
P.O. Box 662, 268 Warren Avenue
Portland, ME 04103-0662

SURETY (Name and Principal Place of Business):
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
AGENCY: P.O. Box 511
Concord, NH 03302-0511

OWNER (Name and Address):
CITY OF PORTLAND
389 Congress Street
Portland, ME 04101

CONSTRUCTION CONTRACT

Date: **July 21, 2006**

Amount: **TWO MILLION SIX HUNDRED NINETY-NINE THOUSAND SIX HUNDRED FORTY-FOUR AND NO/100THS Dollars ($2,699,644.00)**

Description (Name and Location): **RIVERTON ELEMENTARY SCHOOL EXPANSION AND RENOVATIONS, 1600 FOREST AVENUE, PORTLAND, ME # 7706**

BOND

Date (Not earlier than Construction Contract Date): **July 25, 2006**

Amount: **TWO MILLION SIX HUNDRED NINETY-NINE THOUSAND SIX HUNDRED FORTY-FOUR AND NO/100THS Dollars ($2,699,644.00)**

Modifications to this Bond: [X] None [ ] See Page 2

CONTRACTOR AS PRINCIPAL
Company: **LANGFORD & LOW, INC.** (Corporate Seal)

Signature: James A. Langford
Name and Title: **James A. Langford, President**
(Any additional signatures appear on page 2.)

SURETY
Company: **FIDELITY AND DEPOSIT COMPANY OF MARYLAND** (Corporate Seal)

Signature: William Ver Planck
Name and Title: **William Ver Planck – Attorney-In-Fact**

(FOR INFORMATION ONLY - Name, Address and Telephone) AGENT or BROKER:
THE ROWLEY AGENCY, INC.
P. O. Box 511, 139 Loudon Road,Concord, NH 03302-0511

OWNER'S REPRESENTATIVE (Architect, Engineer or other party): **SEMPLE & DRANE ARCHITECTS**
496 Congress Street, 4th Floor
Portland, ME 04101

1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.

3 If there is no Owner Default, the Surety's obligation under this Bond shall arise after:

3.1 The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and

3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and

3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

4 When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or

4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or

4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

.2 Deny liability in whole or in part and notify the Owner citing reasons therefor.

5 If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

6 After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:

6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

7 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators or successors.

8 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

9 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12 DEFINITIONS

12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corporate Seal)	Company:	(Corporate Seal)
Signature:		Signature:	
Name and Title:		Name and Title:	
Address:		Address:	

AIA Document A312

Payment Bond

Bond No. : 08299162

Conforms with the American Institute of Architects, AIA Document A312.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):
LANGFORD & LOW, INC.
P.O. Box 662, 268 Warren Avenue
Portland, ME 04103-0662

SURETY (Name and Principal Place of Business):
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
AGENCY: P.O. Box 511
Concord, NH 03302-0511

OWNER (Name and Address):
CITY OF PORTLAND
389 Congress Street
Portland, ME 04101

CONSTRUCTION CONTRACT

Date: **July 21, 2006**

Amount: **TWO MILLION SIX HUNDRED NINETY-NINE THOUSAND SIX HUNDRED FORTY-FOUR AND NO/100THS Dollars ($2,699,644.00)**

Description (Name and Location): **RIVERTON ELEMENTARY SCHOOL EXPANSION AND RENOVATIONS, 1600 FOREST AVENUE, PORTLAND, ME # 7706**

BOND

Date(Not earlier than Construction Contract Date): **July 25, 2006**

Amount: **TWO MILLION SIX HUNDRED NINETY-NINE THOUSAND SIX HUNDRED FORTY-FOUR AND NO/100THS Dollars ($2,699,644.00)**

Modifications to this Bond: [X] None [ ] See Page 2

CONTRACTOR AS PRINCIPAL
Company: **LANGFORD & LOW, INC.** (Corporate Seal)

Signature: James A. Langford
Name and Title: **James A. Langford, President**
(Any additional signatures appear on page 2.)

(FOR INFORMATION ONLY - Name, Address and Telephone) AGENT or BROKER:
THE ROWLEY AGENCY, INC.
P. O. Box 511, 139 Loudon Road,Concord, NH 03302-0511

SURETY
Company: **FIDELITY AND DEPOSIT COMPANY OF MARYLAND** (Corporate Seal)

Signature: William Ver Planck
Name and Title: **William Ver Planck – Attorney-In-Fact**

OWNER'S REPRESENTATIVE (Architect, Engineer or other party): **SEMPLE & DRANE ARCHITECTS**
496 Congress Street, 4th Floor
Portland, ME 04101

1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.

2 With respect to the Owner, this obligation shall be null and void if the Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2 Defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity whose claim, demand, lien or suit is for the payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.

3 With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4 The Surety shall have no obligation to Claimants under this Bond until:

4.1 Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2 Claimants who do not have a direct contract with the Contractor:

.1 Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and

.2 Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and

.3 Not having been paid within the above 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.

5 If a notice required by paragraph 4 is given by Owner to the Contractor or to the Surety, that is sufficient compliance.

6 When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2 Pay or arrange for payment of any undisputed amounts.

7 The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

9 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

11 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4. 1 or Clause 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (l) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page. Actual receipt of notice by Surety, the Owner or the Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15 DEFINITIONS

15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	(Corporate Seal)	Company:	(Corporate Seal)
Signature:		Signature:	
Name and Title:		Name and Title:	
Address:		Address:	

Power of Attorney
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

KNOW ALL MEN BY THESE PRESENTS: That the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, corporations of the State of Maryland, by WILLIAM J. MILLS, Vice President, and GERALD F. HALEY, Assistant Secretary, in pursuance of authority granted by Article Vl, Section 2, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, does hereby nominate, constitute and appoint **Daniel E. CHURCH, Paula J. CANTARA, Bruce H. LANGLEY, William VER PLANCK, John P. TIMMENY and John T. WHITING, all of Concord, New Hampshire, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its office in Baltimore, Md., in their own proper persons. This power of attorney revokes that issued on behalf of Daniel E. CHURCH, Paula J. CANTARA, Bruce H. LANGLEY, William VER PLANCK, John P. TIMMENY, Heather M. KILLORY, John T. WHITING, dated January 10, 2006.

The said Assistant Secretary does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article VI, Section 2, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President and Assistant Secretary have hereunto subscribed their names and affixed the Corporate Seals of the said FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, this 1st day of February, A.D. 2006.

ATTEST:

FIDELITY AND DEPOSIT COMPANY OF MARYLAND
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

FIDELITY AND DEPOSIT COMPANY OF MARYLAND — INCORPORATED — 1890

COLONIAL AMERICAN CASUALTY AND SURETY COMPANY — SEAL

Gerald F. Haley — By: — William J. Mills

Gerald F. Haley *Assistant Secretary* *William J. Mills* *Vice President*

State of Maryland }
City of Baltimore } ss:

On this 1st day of February, A.D. 2006, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, came WILLIAM J. MILLS, Vice President, and GERALD F. HALEY, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and they each acknowledged the execution of the same, and being by me duly sworn, severally and each for himself deposeth and saith, that they are the said officers of the Companies aforesaid, and that the seals affixed to the preceding instrument is the Corporate Seals of said Companies, and that the said Corporate Seals and their signatures as such officers were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

MARIA D. ADAMSKI — NOTARY PUBLIC — BALTIMORE COUNTY, MD

Maria D. Adamski

Maria D. Adamski *Notary Public*

My Commission Expires: July 8, 2007

EXTRACT FROM BY-LAWS OF FIDELITY AND DEPOSIT COMPANY OF MARYLAND

"Article VI, Section 2. The Chairman of the Board, or the President, or any Executive Vice-President, or any of the Senior Vice-Presidents or Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Assistant Vice-Presidents and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertaking, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgements, decrees, mortgages and instruments in the nature of mortgages,...and to affix the seal of the Company thereto."

EXTRACT FROM BY-LAWS OF COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

"Article VI, Section 2. The Chairman of the Board, or the President, or any Executive Vice-President, or any of the Senior Vice-Presidents or Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Assistant Vice-Presidents and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertaking, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgements, decrees, mortgages and instruments in the nature of mortgages,...and to affix the seal of the Company thereto."

CERTIFICATE

I, the undersigned, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that the Vice-President who executed the said Power of Attorney was one of the additional Vice-Presidents specially authorized by the Board of Directors to appoint any Attorney-in-Fact as provided in Article VI, Section 2, of the respective By-Laws of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990 and of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed."

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies,

this 25th day of July, 2006

Gregg E. Murray

Assistant Secretary

ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 07/25/2006

PRODUCER (603)224-2562 FAX (603)224-8012
The Rowley Agency, Inc.
139 Loudon Road
P.O. Box 511
Concord, NH 03302-0511

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED Langford & Low
P.o. Box 662
Portland, ME 04104

INSURERS AFFORDING COVERAGE	NAIC #
INSURER A: OneBeacon Insurance	0047
INSURER B: Maine Employers Mutual Ins Co	0008
INSURER C:	
INSURER D:	
INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A		GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS MADE [X] OCCUR X CG0001 GEN'L AGGREGATE LIMIT APPLIES PER: POLICY [X] PRO-JECT LOC	YMR824117	05/03/2006	05/03/2007	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 100,000 $ 5,000 $ 1,000,000 $ 2,000,000 $ 2,000,000
A		AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS	YMAH19628	05/03/2006	05/03/2007	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1000000 $ $ $
		GARAGE LIABILITY ANY AUTO				AUTO ONLY - EA ACCIDENT OTHER THAN AUTO ONLY: EA ACC AGG	$ $ $
A		EXCESS/UMBRELLA LIABILITY X OCCUR CLAIMS MADE DEDUCTIBLE X RETENTION $ 10,000	YMDV16088	05/03/2006	05/03/2007	EACH OCCURRENCE AGGREGATE	$ 4,000,000 $ 4,000,000 $ $ $
B		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? If yes, describe under SPECIAL PROVISIONS below	1810068642	05/03/2006	05/03/2007	X WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 500,000 $ 500,000 $ 500,000
A		OTHER Leased/Rented Equipment - 60 days or less	YMR824117	05/03/2006	05/03/2007	Limit $75,000	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS

re: Riverton Elementary School Expansion and renovation project, 1600 Forest Ave., Portland, ME
City of Portland is listed as an additional insured under general liabiality coverage as required by written contract.

CERTIFICATE HOLDER

City of Portland
Purchasing Office
City Hall, Room 103
389 Congress St.
Portland, ME 04101

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE
Christine Holman/CHH

IMPORTANT

If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

DISCLAIMER

The Certificate of Insurance on the reverse side of this form does not constitute a contract between the issuing insurer(s), authorized representative or producer, and the certificate holder, nor does it affirmatively or negatively amend, extend or alter the coverage afforded by the policies listed thereon.

SECTION 00310
FORM FOR BID

PROPOSAL FORM FOR GENERAL CONTRACTORS
(PUBLIC SCHOOL PROJECTS)

BIDDER: Langford & Low, Inc.
248 Warren Ave.
Portland, Maine 04103

TO: Matthew F. Fitzgerald, Purchasing Agent
City Hall, Room 103
389 Congress Street
Portland, ME 04101

A. Having carefully examined the Form of Contract, General Conditions, Special Provisions and Plans and Specifications dated May 9, 2006.

Prepared by: Semple & Drane Architects, the Architects/Engineer for Riverton Expansion and Renovation Project, Portland, Maine.

As well as the premises and conditions affecting the Work, we the undersigned propose to furnish all Labor, Equipment and Materials necessary for and reasonably incidental to the construction and completion of this Proposal for the amount of:

$ 2,985,000.00

NOTE: The bidder acknowledges that the lump-sum amount listed in the Schedule of Allowances indicated in Section 01210 is included in the Base Bid price noted above.

B. Alternate prices as follows:

Alternate #1:	New VAV terminals and Ductwork	ADD $ 133,000
Alternate #2:	Landscaping	ADD $ 10,750
Alternate #3:	Air Handler Unit 7 & 8 and Chiller System	ADD $ 183,000
Alternate #4:	Library Carpet	ADD $ 7,500
Alternate #5:	Fire Protection System	ADD $ 265000
Alternate #6:	Canopy Skylights	ADD $ 78,000

C.	UNIT PRICE SCHEDULE	ADD	DEDUCT
1.	Open Excavation including backfill, Per cubic yard	27	27
2.	Rock excavation, per cubic yard-open (indicate same amount for Add & Deduct)	80	80
3.	Rock excavation, per cubic yard-trench (indicate same amount for Add & Deduct)	130	130
4.	Structural Fill, per cubic yard	18	18
5.	Crushed Stone, per cubic yard	27	27

D. This proposal includes the following Addenda to the Plans and Specifications:

Addendum No. 1, Dated 5-23-06 Addendum No. _____, Dated _____

Addendum No. 2, Dated 5-25-06 Addendum No. _____, Dated _____

Addendum No. 3, Dated 6-6-06 Addendum No. _____, Dated _____

E. The undersigned agrees, if this Proposal is accepted, to sign a Contract and deliver it, along with the Bonds and Affidavits of all Insurance specified within twelve (12) calendar days after the date of notification of such acceptance, except if the 12th day falls on a holiday, a Saturday or Sunday, then the conditions will be fulfilled if the required documents are received before 12 o'clock noon on the day following the holiday, or the Monday following the Saturday or Sunday, and as a guarantee thereof, herewith submits a Certified or Cashier's Check or Bid Bond as required.

The undersigned agrees that each of the above Subcontractors represents a bonafide Subproposal based on the Plans and Specifications and will be used for the Work indicated at the Amount stated, unless a substitution is made by mutual agreement as provided for by the Instructions to Bidders. In the event Alternate Prices are requested and various trades are involved, General Contract Bidders may use properly filed Subproposals even though a change in Subcontractors from those carried in the Base Bid may occur. If different Subcontractors are used because of Alternates, attach supplemental sheets to this Bid Form to indicate such changes.

The undersigned agrees, if awarded the Contract, to complete the work to allow occupancy of building as described in Section 01010 "Summary of Work".

1. Substantial Completion of entire building on or before August 7, 2007:

Signed _____

By James A. Langford, President

Address P.O. Box 662

Portland, Maine 04104

NOTE: If bidder is a Corporation, write State of incorporation, and if a partnership, give full names of all partners.

Maine

ADDENDUM #1

CITY OF PORTLAND, MAINE
Riverton Expansion and Renovation Project
BID #7706

DATE: May 23, 2006

The attention of firms submitting proposals for the work named in the above Invitation is called to the following modifications to the documents as were issued.

The items set forth herein, whether of clarification, omission, addition and/or substitution, shall be included and form a part of the Contractor's submitted material and the corresponding Contract when executed. No claim for additional compensation, due to lack of knowledge of the contents of this Addendum will be considered.

****

ALL BIDDERS ARE ADVISED THAT RECEIPT OF THIS NOTICE MUST BE DULY ACKNOWLEDGED ON THE BID PROPOSAL FORM OR BY THE INSERTION OF THIS SHEET, SIGNED, AND SUBMITTED WITH YOUR PROPOSAL.

****

MATTHEW F. FITZGERALD
PURCHASING AGENT

Please be advised that the bid opening date and time for this project have been postponed to 3:00pm, Tuesday, June 13th, 2006. Please note that answers to questions that have already been submitted will be included in Addendum #2, which will be mailed to all registered plan holders as soon as possible.

Receipt of **Addendum No. 1** to the City of Portland's **BID #7706: Riverton Expansion and Renovation Project,** is hereby acknowledged.

COMPANY NAME: LANGFORD + LOW INC.

SIGNED BY: James A. Langford DATE: 6-8-06

PRINT NAME & TITLE: JAMES A. LANGFORD Pres.

ADDRESS: P.O. Box 662

Portland, ME 04104
Zip Code

ADDENDUM #3

CITY OF PORTLAND, MAINE
Riverton Expansion and Renovation Project
BID #7706

DATE: June 6, 2006

The attention of firms submitting proposals for the work named in the above Invitation is called to the following modifications to the documents as were issued.

The items set forth herein, whether of clarification, omission, addition and/or substitution, shall be included and form a part of the Contractor's submitted material and the corresponding Contract when executed. No claim for additional compensation, due to lack of knowledge of the contents of this Addendum will be considered.

****

ALL BIDDERS ARE ADVISED THAT RECEIPT OF THIS NOTICE MUST BE DULY ACKNOWLEDGED ON THE BID PROPOSAL FORM OR BY THE INSERTION OF THIS SHEET, SIGNED, AND SUBMITTED WITH YOUR PROPOSAL.

****

MATTHEW F. FITZGERALD
PURCHASING AGENT

Please See Attached.

Receipt of **Addendum No. 3** to the City of Portland's **BID #7706: Riverton Expansion and Renovation Project**, is hereby acknowledged.

COMPANY NAME: LANGFORD + LOW, INC.

SIGNED BY: James A. Langford DATE: 6-8-06

PRINT NAME & TITLE: JAMES A. LANGFORD PRES.

ADDRESS: P.O. Box 662

Portland, ME 04104
Zip Code

BID BOND

Conforms with The American Institute of Architects, A.I.A. Document No. A-310

KNOW ALL BY THESE PRESENTS, That we, **LANGFORD & LOW, INC.**

P.O. Box 662, Portland, Maine 04103-0662

as Principal, hereinafter called the Principal,

and the **FIDELITY AND DEPOSIT COMPANY OF MARYLAND**,

of **AGENCY: P. O. Box 511, Concord, NH 03302-0511**, a corporation duly organized under the laws of the State of **Maryland**, as Surety, hereinafter called the Surety, are held and firmly bound unto

CITY OF PORTLAND, 389 Congress Street, Portland, ME 04101 as Obligee, hereinafter called the Obligee,

in the sum of **FIVE PERCENT OF AMOUNT BID**

Dollars (**5% OF AMOUNT BID**), for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

RIVERTON ELEMENTARY SCHOOL EXPANSION AND RENOVATIONS, 1600 FOREST AVENUE, PORTLAND, ME # 7706

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this **13th** day of **June**, **2006**.

Diane M Clark
Witness

LANGFORD & LOW, INC. (Seal)
Principal

Diane G. Langford Pres
Title

Christine Darling
Witness

Christine Darling

FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: William Ver Planck
William Ver Planck Attorney-in-Fact

Power of Attorney
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

KNOW ALL MEN BY THESE PRESENTS: That the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, corporations of the State of Maryland, by WILLIAM J. MILLS, Vice President, and GERALD F. HALEY, Assistant Secretary, in pursuance of authority granted by Article VI, Section 2, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, does hereby nominate, constitute and appoint **Daniel E. CHURCH, Paula J. CANTARA, Bruce H. LANGLEY, William VER PLANCK, John P. TIMMENY and John T. WHITING, all of Concord, New Hampshire, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its office in Baltimore, Md., in their own proper persons. This power of attorney revokes that issued on behalf of Daniel E. CHURCH, Paula J. CANTARA, Bruce H. LANGLEY, William VER PLANCK, John P. TIMMENY, Heather M. KILLORY, John T. WHITING, dated January 10, 2006.

The said Assistant Secretary does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article VI, Section 2, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President and Assistant Secretary have hereunto subscribed their names and affixed the Corporate Seals of the said FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, this 1st day of February, A.D. 2006.

ATTEST:

FIDELITY AND DEPOSIT COMPANY OF MARYLAND
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

FIDELITY AND DEPOSIT COMPANY INCORPORATED 1890 OF MARYLAND

COLONIAL AMERICAN CASUALTY AND SURETY COMPANY SEAL

By:

Gerald F. Haley *Assistant Secretary* *William J. Mills* *Vice President*

State of Maryland }
City of Baltimore } ss:

On this 1st day of February, A.D. 2006, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, came WILLIAM J. MILLS, Vice President, and GERALD F. HALEY, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and they each acknowledged the execution of the same, and being by me duly sworn, severally and each for himself deposeth and saith, that they are the said officers of the Companies aforesaid, and that the seals affixed to the preceding instrument is the Corporate Seals of said Companies, and that the said Corporate Seals and their signatures as such officers were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

MARIA D. ADAMSKI NOTARY PUBLIC BALTIMORE COUNTY MD

Maria D. Adamski *Notary Public*
My Commission Expires: July 8, 2007

EXTRACT FROM BY-LAWS OF FIDELITY AND DEPOSIT COMPANY OF MARYLAND

"Article VI, Section 2. The Chairman of the Board, or the President, or any Executive Vice-President, or any of the Senior Vice-Presidents or Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Assistant Vice-Presidents and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertaking, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgements, decrees, mortgages and instruments in the nature of mortgages,...and to affix the seal of the Company thereto."

EXTRACT FROM BY-LAWS OF COLONIAL AMERICAN CASUALTY AND SURETY COMPANY

"Article VI, Section 2. The Chairman of the Board, or the President, or any Executive Vice-President, or any of the Senior Vice-Presidents or Vice-Presidents specially authorized so to do by the Board of Directors or by the Executive Committee, shall have power, by and with the concurrence of the Secretary or any one of the Assistant Secretaries, to appoint Resident Vice-Presidents, Assistant Vice-Presidents and Attorneys-in-Fact as the business of the Company may require, or to authorize any person or persons to execute on behalf of the Company any bonds, undertaking, recognizances, stipulations, policies, contracts, agreements, deeds, and releases and assignments of judgements, decrees, mortgages and instruments in the nature of mortgages,...and to affix the seal of the Company thereto."

CERTIFICATE

I, the undersigned, Assistant Secretary of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that the Vice-President who executed the said Power of Attorney was one of the additional Vice-Presidents specially authorized by the Board of Directors to appoint any Attorney-in-Fact as provided in Article VI, Section 2, of the respective By-Laws of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, and the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990 and of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed."

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies,

this 13 day of May, 2006.

George E. Murray

Assistant Secretary

SECTION 00420

NOTICE OF AWARD

To: _____

_____

_____

Project Description: Renovations to the Riverton Elementary School

The OWNER has considered the Bid submitted by you for the above described Work in response to its advertisement for Bids dated May 7, 2006, and Information for Bidders.

You are hereby notified that your Bid has been accepted for items in the amount of $_____

You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance Bond, Payment Bond and certificates of insurance within ten (10) calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said Bonds within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your Bid as abandoned. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the OWNER.

Dated this the _____ day of _____, 2006.

OWNER: _____
City of Portland

By: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

by _____

Dated this the _____ day of _____, 2006.

By _____

Title _____

END OF SECTION

SECTION 00580

NOTICE TO PROCEED

To: _____

_____

_____

_____

Date: _____

Project: RIVERTON EXPANSION AND RENOVATION, Forest Ave., Portland, Maine

You are hereby notified to commence Work in accordance with the Agreement dated _____, 2006, on _____, 2006.

The date of final completion of all Work is _____, 2006.

Dated this the _____ day of _____, 2006.

OWNER: _____
City of Portland

By: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

by _____

Dated this the _____ day of _____, 2006.

By _____

Title _____

END OF SECTION

CONTRACT AGREEMENT

(Public School Project)

THIS AGREEMENT made the ___ day of June 2006 by and between the **CITY OF PORTLAND**, a body politic and corporate with a place of business at 389 Congress Street, Portland, Maine (hereinafter "**OWNER**") and _____, with a mailing address of _____ (hereinafter "**CONTRACTOR**").

W I T N E S S E T H:

That the **OWNER** and the **CONTRACTOR** for the considerations hereinafter named, agree as follows:

ARTICLE 1. SCOPE OF WORK

The **CONTRACTOR** shall furnish all of the materials and perform all the work shown on the plans and described in the specifications entitled City of Portland Bid No. 7706 For Riverton Expansion and Renovation Project Prepared by Semple & Drane Architects acting as and in these Contract Documents entitled Architect; and shall do everything required by this Agreement, the General Conditions, Supplementary General Conditions, General Requirements and Special Conditions of the Contract, the Specification and the Drawings, and Supplemental Provisions to Revised Drawings.

ARTICLE 2. TIME OF COMPLETION

The work to be preformed under this Contract shall be substantially completed on or before August 7, 2007, and the building shall be ready for occupancy on or before August 25, 2007.

ARTICLE 3. THE CONTRACT SUM

The **OWNER** shall pay the **CONTRACTOR** for the performance of the Contract, subject to additions and deductions provided therein, in current funds as follows _____ ($_____). The original plans and specifications and the Contract Sum is based on Exhibit A attached hereto.

ARTICLE 4. CONTRACT BOND

The **CONTRACTOR** shall furnish the **OWNER** the approved Contract Bonds (as per Article _____ of the Standard General Conditions) in the amount of 100% of the Contract Sum.

ARTICLE 5. PROGRESS PAYMENTS

The **OWNER** shall make payments on account of the Contract as provided therein as follows: each month 95% of the value, based on Contract prices of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as certified by the Architect.

The **OWNER** may cause **CONTRACTOR** to be paid such portion of the amount retained hereunder in accordance with Article 9 of the General Conditions and Article 9 of the Supplementary General Conditions.

ARTICLE 6. FINAL PAYMENT

Final payment shall be due 90 days after completion and acceptance of the Work, provided the **CONTRACTOR** has submitted evidence satisfactory to the **OWNER** that all payrolls, materials, bills and other indebtedness connected with the Work has been paid.

ARTICLE 7. THE CONTRACT DOCUMENTS

The General Conditions of the Contract, Instructions to Bidders, the Proposal, the Special Conditions, the Supplementary General Conditions, the Specifications, the General Requirements, the Plans and the Drawings together with this Agreement form the Contract, and they are as fully a part of the Contract as if hereto attached or herein repeated. The following is an enumeration of the Specifications and the Plans.

SPECIFICATIONS:

See attached Table of Contents: Riverton School, Portland, Maine, Project #7706 project manual.

ADDENDA:

Addendum No. 1, Dated _____, 2006
Addendum No. 2, Dated _____, 2006
Addendum No. 3, Dated _____, 2006
Addendum No. 4, Dated _____, 2006
Addendum No. 5, Dated _____, 2006
Addendum No. 6, Dated _____, 2006

PLANS:

Riverton Expansion and Renovation Plans dated May 9, 2006.

DRAWINGS:

See List of Drawings and Revised Drawings, Project #7706.

Section 3.2.1 of the Supplementary General Conditions is deleted in its entirety and restated as follows:

Before starting the Work, and at frequent intervals during the progress thereof, the Contractor shall carefully review and compare the Contract Documents with each other and with the information furnished by the Owner pursuant to Subparagraph 2.2.2 and shall at once report to the Architect any error, inconsistency or omission the Contractor may discover. Any necessary change shall be ordered as provided in Article 7, subject to the requirements of Paragraph 1.2 and other provisions of the Contract Documents. If the Contractor proceeds with the Work without such notice to the Architect, having discovered such errors, inconsistencies or omissions, the Contractor shall bear all costs arising there from.

The **OWNER** and the **CONTRACTOR** hereby agree to the full performance of the covenants herein.

IN WITNESS WHEREOF the parties hereto have executed this Agreement.

WITNESS

CONTRACTOR

By: _____

Its: Vice President

Print or Type Name: Daniel G. Williams

WITNESS

CITY OF PORTLAND

By: _____
Joseph E. Gray, Jr.
Its City Manager

Approved as to form:

_____
Office of Corporation Counsel

Approved as to funds:

_____
Budget Office

c/mydocs/mff 7706-contract.doc

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

TABLE OF CONTENTS

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 1 - GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents consist of the Agreement between Owner and Contractor (hereinafter the Agreement), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include other documents such as bidding requirements (advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or portions of addenda relating to bidding requirements).

1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Architect and Contractor, (2) between the Owner and a Subcontractor or Sub-subcontractor or (3) between any persons or entities other than the Owner and Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or part of the Project.

1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirement for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

1.1.7 THE PROJECT MANUAL

The Project Manual is the volume usually assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 The Contract Documents shall be signed by the Owner and Contractor as provided in the Agreement. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

1.2.2 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

1.2.3 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.4 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.2.5 Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.3 OWNERSHIP, AND USE OF ARCHITECT'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS

1.3.1 The Drawings, Specifications and other documents prepared by the Architect are instruments of the Architect's service through which the Work to be executed by the Contractor is described. The Contractor may retain one contract record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect, and unless otherwise indicated the Architect shall be deemed the author of them and will retain all common law, statutory and other reserved rights, in addition to the copyright. All copies of them, except the Contractor's record set, shall be returned or suitably accounted for to the Architect, on request, upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner and Architect. The Contractor, Subcontractors, Sub-subcontractors and material and equipment suppliers are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's copyright or other reserved rights.

1.4 CAPITALIZATION

1.4.1 Terms capitalized in these General Conditions include those which are (1) specifically defined, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document or (3) the titles of other documents published by the American Institute of Architects.

1.5 INTERPRETATION

1.5.1 In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

ARTICLE 2 - OWNER

2.1 DEFINITION

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Owner" means the Owner or the Owner's authorized representative.

2.1.2 The Owner upon reasonable written request shall furnish to the Contractor in writing information which is necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein at the time of execution of the Agreement and, within five days after any change, information of such change in title, recorded or unrecorded.

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.1 The Owner shall, at the request of the Contractor, prior to execution of the Agreement and promptly from time to time thereafter, furnish to the Contractor reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. (**Note:** Unless such reasonable evidence were furnished on request prior to the execution of the Agreement, the prospective contractor would not be required to execute the Agreement or to commence the Work.)

2.2.2 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.

2.2.3 Except for permits and fees which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

2.2.4 Information or services under the Owner's control shall be furnished by the Owner with reasonable promptness to avoid delay in orderly progress of the Work.

2.2.5 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals as are reasonably necessary for execution of the Work.

2.2.6 The foregoing are in addition to other duties and responsibilities of the Owner enumerated herein and especially those in respect to Article 6 (Construction by Owner or by Separate Contractors), Article 9 (Payments and Completion) and Article 11 (Insurance and Bonds).

2.3 OWNER'S RIGHT TO STOP THE WORK

2.3.1 If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner, by written order signed personally or by an agent specifically so empowered by the Owner in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3.

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a second seven-day period. If the Contractor within such second seven-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner 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 cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 - CONTRACTOR

3.1 DEFINITION

3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner pursuant to Subparagraph 2.2.2 and shall at once report to the Architect errors, inconsistencies or omissions discovered. The Contractor shall not be liable to the Owner or Architect for damage resulting from errors, inconsistencies or omission in the Contract Documents unless the Contractor recognized such error, inconsistency or omission and knowingly failed to report it to the Architect. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Architect, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.2.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.

3.2.3 The Contractor shall perform the Work in accordance with the Contract Documents and submittals approved pursuant to Paragraph 3.12.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.

3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor.

3.3.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.3.4 The Contractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper conditions to receive subsequent Work.

3.4 LABOR AND MATERIALS

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

3.4.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.5 WARRANTY

3.5.1 The CONTRACTOR warrants to the OWNER that materials and equipment furnished under the Contract will be of good quality and new, fit for the purposes for which they are intended and of merchantable quality, unless otherwise required or permitted by the Contract Documents; that the work will be free from defects not inherent in the quality required or permitted; and that the work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The CONTRACTOR'S warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the CONTRACTOR, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the OWNER, the CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

3.6 TAXES

3.6.1 The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

3.7 PERMITS, FEES AND NOTICES

3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are legally required when bids are received or negotiations concluded.

3.7.2 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities bearing on performance of the Work.

3.7.3 It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations. However, if the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate Modification.

3.7.4 If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs.

3.8 ALLOWANCES

3.8.1 The Contract shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities against which the Contractor makes reasonable objection.

3.8.2 Unless otherwise provided in the Contract Documents:

.1 materials and equipment under an allowance shall be selected promptly by the Owner to avoid delay in the Work;

.2 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts.

.3 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances;

.4 whenever costs are more than or less than allowances, the Contract Sum shall be

adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Clause 3.8.1.1 and (2) changes in Contractor's costs under Clause 3.8.2.3.

3.9 SUPERINTENDENT

3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule of the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the work.

3.10.2 The Contractor shall prepare and keep current, for the Architects' approval, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows the Architect reasonable time to review submittals.

3.10.3 The Contractor shall conform to the most recent schedules.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

3.11.1 The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, addenda, Change Orders and other Modifications, in good order and marked currently to record changes and selections made during construction, and in addition approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.1 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.

3.12.2 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.

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

3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect is subject to the limitations of Subparagraph 4.2.7.

3.12.5 The Contractor shall review, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals made by the Contractor which are not required by the Contract Documents may be returned without action.

3.12.6 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved submittals.

3.12.7 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract Documents.

3.12.8 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 Architect in writing of such deviation at the time of submittal and the Architect has given written approval to the specific 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.

3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, or revisions other than those requested by the Architect on previous submittals.

3.12.10 Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents.

3.12.11 When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

3.13 USE OF SITE

3.13.1 The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

3.14 CUTTING AND PATCHING

3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.15 CLEANING UP

3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools construction equipment, machinery and surplus materials.

3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.16 ACCESS TO WORK

3.16.1 The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

3.17 ROYALTIES AND PATENTS

3.17.1 The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

3.18 INDEMNIFICATION

3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, to the extent

caused in whole or in part by negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph 3.18.

3.18.2 In claims against any person or entity indemnified under this Paragraph 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Paragraph 3.18 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.18.3 The obligations of the Contractor under this Paragraph 3.18 shall not extend to the liability of the Architect, the Architect's consultants, and agents and employees of any of them arising out of (1) the

preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (2) the giving of or the failure to give directions or instructions by the Architect, the Architect's consultants, and agents and employees of any of them provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 4 - ADMINISTRATION OF THE CONTRACT

4.1 ARCHITECT

4.1.1 The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

4.1.3 In case of termination of employment of the Architect, the Owner shall appoint an architect against whom the Contractor makes no reasonable objection and whose status under the Contract Documents shall be that of the former architect.

4.1.4 Disputes arising under Subparagraphs 4.1.2 and 4.1.3 shall be subject to arbitrations.

4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents, and will be the Owner's representative (1) during construction (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the correction period described in Paragraph 12.2. The Architect will advise and consult with the Owner. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified by written instrument in accordance with other provisions of the Contract.

4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work to determine in general if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work. On the basis of on-site observations as an architect, the Architect will keep the Owner informed of progress of the Work, and will endeavor to guard the Owner against defects and deficiencies in the Work.

4.2.3 The Architect will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility as provided in Paragraph 3.3. The Architect will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or of any other persons performing portions of the Work.

4.2.4 **Communications Facilitating Contract Administration.** Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate through the Architect. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

4.25 Based on the Architect's observations and evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificate for Payment in such amounts.

4.2.6 The Architect will have authority to reject Work which does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable for implementation of the intent of the Contract Documents, the Architect will have authority to require additional inspection or testing of the Work in accordance with Subparagraphs 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

4.2.7 The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for a limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the

Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, or any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.

4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion, will receive and forward to the Owner for the Owner's review and records written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

4.2.11 The Architect will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made with reasonable promptness and within any time limits agreed upon. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions so rendered in good faith.

4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

4.3 CLAIMS AND DISPUTES

4.3.1 **Definition.** A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

4.3.2 **Decision of Architect.** Claims, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for action as provided in Paragraph 4.4. A decision by the Architect, as provided in Subparagraph 4.4.4, shall be required as a condition precedent to mediation, arbitration or litigation of a Claim between the Contractor and Owner as to all such matters arising prior to the date final payment is due, regardless of (1) whether such matters relate to execution and progress of the Work or (2) the extent to which the Work has been completed. The decision by the Architect in response to a Claim shall not be a condition precedent to mediation, arbitration or litigation in the event (1) the position of Architect is vacant, (2) the Architect has not received evidence or has failed to render a decision within agreed time limits, (3) the Architect has failed to take action required under Subparagraph 4.4.4 within 30 days after the Claim is made, (4) 45 days have passed after the Claim has been referred to the Architect or (5) the Claim relates to a mechanic's lien.

4.3.3 **Time Limits on Claims.** Claims by either party must be made within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been implemented by Change Order will not be considered unless submitted in a timely manner.

4.3.4 **Continuing Contract Performance.** Pending final resolution of a Claim including arbitration, unless otherwise agreed in writing the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

4.3.5 **Waiver of Claims: Final Payment.** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

.1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

.2 failure of the Work to comply with the requirements of the Contract Documents; or

.3 terms of special warranties required by the Contract Documents.

4.3.6 **Claims for Concealed or Unknown Conditions.** If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the Architect has given notice of the decision. If the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

4.3.7 **Claims for Additional Cost.** If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.3. If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claims shall be filed in accordance with the procedure established herein.

4.3.8 **Claims for Additional Time.**

4.3.8.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

4.3.8.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the scheduled construction.

4.3.9 **Injury or Damage to Person or Property.** If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in Subparagraphs 4.3.7 or 4.3.8.

4.4 **RESOLUTION OF CLAIMS AND DISPUTES**

4.4.1 The Architect will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Architect expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Architect may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

4.4.2 If a Claim has been resolved, the Architect will prepare or obtain appropriate documentation.

4.4.3 If a Claim has not been resolved, the party making the Claim shall, within ten days after the Architect's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Architect, (2) modify the initial Claim or (3) notify the Architect that the initial Claim stands.

4.4.4 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven days, which decision shall be final and binding on the parties but subject to mediation or arbitration. Upon expiration of such time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Contractor's default,

the Architect may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

4.5 ARBITRATION / MEDIATION or COURT

4.5.1 Dispute Resolutions. The OWNER and the CONTRACTOR mutually desire to avoid construction disputes. When such disputes are unavoidable, however, they agree to participate in good faith in the dispute resolution processes described below in an effort to obtain fast, fair, and cost effective resolutions.

A. Partnering.

When a complaint or claim has been filed, the general contractor and all related subcontractors shall make the records relating to the claim available within a reasonable time for copying and inspection.

B. Non-binding Mediation.

In the absence of a dispute review board or in the event a dispute should remain unresolved, and the claim is for less than $200,000.00, the parties shall participate in non-binding mediation, pursuant to the construction Industry Mediation Rules of the American Arbitration Association.

C. Arbitration.

1. All disputes between the parties (including claims and counterclaims), that exceed $200,000.00 except as provided herein, r elating to completion of the project in accordance with the contract documents, will be decided by arbitration.

2. Except as provided herein, arbitration shall be conducted in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association.

3. Notwithstanding the above, the arbitrator shall have no jurisdiction to hear disputes (including claims and counterclaims) which seek:

(a) specific performance;
(b) injunctive relief;
(c) an award of damages based on an alleged tort by the other party;
(d) punitive damages;
(e) interest payments, including interest payments on construction loans; or
(f) consequential damages. (The arbitrator's jurisdiction is limited to matters which are the natural and proximate consequence of failure to complete the project in accordance with the contract documents. Without limitation, the arbitrator shall not have jurisdiction to hear claims for lost profits or business, impairment of earning capacity, or loss of time or earnings.)

4. Any question regarding the jurisdiction of the arbitrator, as limited herein, shall be expressly reserved for determination by the courts of the State of Maine.

5. The parties agree that any dispute submitted to arbitration, as limited herein, shall be determined in conformity with the applicable substantive law of the State of Maine, and the arbitrator's authority to make any award shall be limited by this provision.

6. The award shall be in writing and shall set forth the arbitrator's finding of fact and conclusions of law in a form sufficient to appraise the parties and the court of the basis for the decision.

7. The arbitrator's determination of facts shall be final and conclusive, provided there is substantial evidence in the record to support such determinations.

8. The award is subject to review by the Superior Court, sitting without a jury, which may affirm, modify or reverse the award.

9. The time for seeking review by the Superior Court shall be that provided in 14 M.R.S.A. Section 5938, as amended. Review by the court shall be based upon the record of proceedings before the arbitrator, unless the court, by order, provides otherwise. The plaintiff shall have the responsibility to prepare the record of proceedings and its submission to the court; and, in so doing, shall observe the time periods and other responsibilities imposed on a plaintiff as though the review was a Rule 80B appeal.

10. During arbitration and until there has been a final judgment confirming, modifying or correcting the award, no party shall commence nor prosecute any suit, action or proceeding touching upon any of the matters submitted to arbitration.

11. At all times during the course of arbitration and judicial review thereof, the CONTRACTOR shall proceed with the work as directed, in a diligent manner and without delay, shall conform to the Owner's decision or order as authorized by the contract documents, and shall be governed by the applicable provision of the contract documents.

D. Waiver of Jury Trial.

In the event any dispute between the parties should either not be resolved by the alternate dispute methods provided for herein or should be outside the jurisdiction of the arbitrator, then the parties hereby knowingly, willingly and voluntarily waive any right which they may have to trial by jury. They agree that any such proceeding shall be heard before a single judge of the Maine Superior Court or the United States District Court.

ARTICLE 5 - SUBCONTRACTORS

5.1 DEFINITIONS

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The

term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no reasonable objection.

5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. The Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued. However, no increase in the Contract Sum shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

5.2.4 The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such change.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By 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 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 Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreement with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors shall similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractor.

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner provided that:

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor in writing; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

5.4.2 If the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted.

ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to

insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such actions by the Owner, the Contractor shall make such Claim as provided elsewhere in the Contract Documents.

6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule and Contract Sum deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgement that the Owner's or separate contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

6.2.3 Costs caused by delays or by improperly timed activities or defective construction shall be borne by the party responsible therefore.

6.2.4 The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Subparagraph 10.2.5.

6.2.5 Claims and other disputes and matters in question between the Contractor and a separate contractor shall be subject to the provisions of Paragraph 4.3 provided the separate contractor has reciprocal obligations.

6.2.6 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Paragraph 3.14.

6.3 OWNER'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish as described in Paragraph 3.15, the Owner may clean up and allocate the cost among those responsible as the Architect determines to be just.

ARTICLE 7 - CHANGES IN THE WORK

7.1 CHANGES

7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the work may be issued by the Architect alone.

7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

7.1.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Directive that application of such unit prices to quantities of Work proposed will

cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

7.2 CHANGE ORDERS

7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect, stating their agreement upon all of the following:

.1 a change in the Work;
.2 the amount of the adjustment in the Contract Sum, if any; and
.3 the extent of the adjustment in the Contract Time, if any.

7.2.2 Methods used in determining adjustments to the Contract Sum may include those listed in Subparagraph 7.3.3

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 unit prices stated in the Contract Documents or subsequently agreed upon;
.3 cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 as provided in Subparagraph 7.3.6.

7.3.4 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

7.3.5 A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the Architect on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. In such case, and also under Clause 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.6 shall be limited to the following:

.1 cost of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' or workmen's compensation insurance;
.2 cost of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
.3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
.4 cost of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
.5 additional costs of supervision and field office personnel directly attributable to the change.

7.3.7 Pending final determination of cost to the Owner, amounts not in dispute may be included in Applications for Payment. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

7.3.8 If the Owner and Contractor do not agree with the adjustment in Contract Time or the method for determining it, the adjustment or the method shall be referred to the Architect for determination.

7.3.9 When the Owner and Contractor agree with the determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

7.4 MINOR CHANGES IN THE WORK

7.4.1 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE 8 - TIME

8.1 DEFINITIONS

8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

8.1.2 The date of commencement of the Work is the date established in the Agreement. The date shall not be postponed by the failure to act of the Contractor or of persons or entities for whom the Contractor is responsible.

8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Paragraph 9.8.

8.1.4 The term "day" as used in the Contract Documents shall mean calendar days unless otherwise specifically defined.

8.2 PROGRESS AND COMPLETION

8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 If the Contractor is delayed at any time in progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending arbitration, or by other causes which the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.

8.3.3 This Paragraph 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contract for performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.3 APPLICATIONS FOR PAYMENT

9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for elsewhere in the Contract Documents.

9.3.1.1 Such applications may include request for payment on account of changes in the Work which have been properly authorized by Construction Directives but not yet included in Change Orders.

9.3.1.2 Such applications may not include request for payment of amounts the Contractor does not intend to pay a Subcontractor or material supplier because of a dispute or other reason.

9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitable stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application of Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

9.4 CERTIFICATES FOR PAYMENT

9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1.

9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's observations at the site and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect's knowledge, information and belief, quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

9.5.1 The Architect may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also decide not to certify payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss because of:

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims;
.3 failure of the Contractor to make payments properly to Subcontractors of 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 Owner or another 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 persistent failure to carry out the Work in accordance with the Contract Documents.

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

9.6 PROGRESS PAYMENTS

9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

9.6.2 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such 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 similar manner.

9.6.3 The Architect 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 Architect and Owner on account of portions of the Work done by such Subcontractor.

9.6.4 Neither the Owner 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.

9.6.5 Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3 and 9.6.4.

9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.7 FAILURE OF PAYMENT

9.7.1 If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by arbitration, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, which shall be accomplished as provided in Article 7.

9.8 SUBSTANTIAL COMPLETION

9.8.1 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 Owner can occupy or utilize the Work for its intended use.

9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected. The Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not in accordance with the requirements of the Contract Documents, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notifications by the Architect. The Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall finish all items on the list accompanying the Certificate Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

9.8.3 Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the Architect, the Owner shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents.

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Subparagraph 11.2.11 and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance,

heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Subparagraph 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonable withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's observations 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 said final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Subparagraph 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) 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 as least 30 days' prior written notice has been given to the Owner, (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 Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claim, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorney's fee.

9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims. The making of final payment shall constitute a waiver of claims by the Owner as provided in Subparagraph 4.3.5.

9.10.4 Acceptanee of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment. Such waivers shall be in addition to the waiver described in Subparagraph 4.3.5.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

10.1.2 In the event the Contractor encounters on the site material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) which has not been rendered harmless, the Contractor shall immediately

stop Work in the area affected and report the condition to the Owner and Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless, by written agreement of the Owner and Contractor, or in accordance with final determination by the Architect on which arbitration has not been demanded, or by arbitration under Article 4.

10.1.3 The Contractor shall not be required pursuant to Article 7 to perform without consent any Work relating to asbestos or polychlorinated biphenyl (PCB).

10.1.4 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Work in the affected area if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in party be negligent acts or omissions of the Owner, anyone directly or indirectly employed by the Owner or anyone for whose acts the Owner may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Subparagraph 10.1.4.

10.2 SAFETY OF PERSONS AND PROPERTY

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

.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

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

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Clauses 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Clauses 10.2.1.2 and 01.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect 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 the Contractor's obligations under Paragraph 3.18.

10.2.6 The Contractor shall designate a responsible member of the Contractor's 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 Owner and Architect.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded as to endanger its safety.

10.3 EMERGENCIES

10.3.1 In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Paragraph 4.3 and Article 7.

ARTICLE 11 - INSURANCE AND BONDS

11.1 **CONTRACTOR's Insurance Requirements.** Neither the CONTRACTOR nor any Subcontractor shall commence work under this Contract until they have provided the insurance coverage required by this Contract and such coverage has been approved by the OWNER.

(a) Worker's Compensation Insurance. The CONTRACTOR and Subcontractors shall procure and maintain, at their own expense, and show evidence to the OWNER of Worker's Compensation coverage as well as Employer's Liability Coverage for their employees, including employees engaged in hazardous work. All such policies which are in any way related to the work and which are secured and maintained by the CONTRACTOR or any tier of Subcontractors shall include clauses requiring that each underwriter shall waive all of its rights of recovery under subrogation or otherwise against the OWNER.

(b) Public Liability and Property Damage Insurance. The CONTRACTOR and Subcontractors shall procure and maintain during the life of the Contract, at their own cost, and show evidence to the OWNER of public Liability and Property Damage Insurance, including special broad form property damage coverage, to protect them from claims and damages which may arise from operations under this Contract, whether such operations shall be performed by themselves or by anyone directly or indirectly employed by them, in the types and minimum amounts set forth below:

Description	Coverage	Each Occurrence
(i) CONTRACTOR's Liability		
	B.I./Death	$5,000,000.00
	P.D.	$5,000,000.00
(ii) CONTRACTOR's Protective		
	B.I./Death	$5,000,000.00
	P.D.	$5,000,000.00
(iii) Vehicle Liability, including owned, hired or non-owned.		
	B.I. / Death	$5,000,000.00
	P.D.	$5,000,000.00
(iv) Employer's Liability		
	B.I./Death	$5,000,000.00

The OWNER shall be named as an additional insured in all such policies; and for items (i) and (ii) above, such policies shall bear a job-aggregate endorsement in the amount of Five Million Dollars ($5,000,000.00).

(c) Special Hazards Insurance. The CONTRACTOR and all Subcontractors will also provide and maintain special hazards insurance, including, but not limited to, coverage for damages resulting from explosion or blasting, collapse, or underground damage in the minimum amounts of Five Million Dollars ($5,000,000.00) for bodily injury and death and Five Million Dollars ($5,000,000.00) for property damage.

(d) Builder's Risk. The CONTRACTOR shall provide and maintain Builder's Risk Insurance, on new construction and similar coverage for the rehabilitation part of the project naming the OWNER and the subcontractors as their interests may appear, as additional insureds, for the perils of fire, extended coverage, vandalism, malicious mischief, and sprinkler leakage on the entire structure on which the work of this contract is to be provided in an amount equivalent to One Hundred Percent (100%) of the Contract amount, and, to the extent possible, upon the standard forms for such coverage as promulgated by the insurance service office of Maine.

(e) Deductible Amount. The CONTRACTOR and Subcontractors will reimburse the OWNER and hold it harmless from the cost of any losses for which they are responsible and to which a deductible amount may apply. The deductible amount in any such policy may not exceed Twenty-five Thousand Dollars ($25,000.00) without the written consent of the OWNER.

(f) Certificate of Insurance. The CONTRACTOR and Subcontractors will provide the OWNER with either certificates of insurance or certified copies of the applicable policies, showing that they have complied with these provision, and such certificates shall provide that thirty (30) days' written notice of non-renewal, material modification, or cancellation must be given to the Owner, Architect, and the Bureau of General Services, prior to the effective date of such non-renewal, material modification, or cancellation. The General CONTRACTOR shall furnish the Architect with four (4) copies of the Certificates of Insurance.

(g) Claims-made Policies. Claims-made policies will not be accepted.

11.4 PERFORMANCE BOND AND PAYMENT BOND

11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment obligations arising there under as stipulated in bidding

requirements or specifically required in the Contract Documents on the date of execution of the Contract.

11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

12.1 UNCOVERING OF WORK

12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect, be uncovered for the Architect's observations and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect has not specifically requested to observe prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

12.2 CORRECTION OF WORK

12.2.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby.

12.2.2 If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Subparagraph 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This period of one year shall be extended with respect to portions of Work first performed after Substantial Completion and the actual performance of the Work. This obligation under this Subparagraph 12.2.2 shall survive acceptance of the Work under the Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

12.2.3 The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Paragraph 2.4. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Architect, the Owner may remove it and store the salvable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten days after written notice, the Owner may upon ten additional days written notice sell such materials and equipment at auction or at private sale and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Contractor, including compensation for the Architect's services and expenses made necessary thereby. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract Sum shall be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the time period of one year as described in Subparagraph 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3 ACCEPTANCE OF NONCONFORMING WORK

12.3.1 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

13.1.1 The Contract shall be governed by the law of the place where the Project is located.

13.2 SUCCESSORS AND ASSIGNS

13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, the party shall nevertheless remain legally responsible for all obligations under the Contract.

13.3 WRITTEN NOTICE

13.3.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or a member or the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

13.4 RIGHTS AND REMEDIES

13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available there under shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right of duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescent in breach there under, except as may specifically agreed in writing.

13.5 TESTS AND INSPECTIONS

13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so the Architect may observe such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so the Architect may observe such procedures. The Owner shall bear such costs except as provided in Subparagraph 13.5.3.

13.5.3 If such procedures for testing, inspection or approval under Subparagraph 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses.

13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.6 INTEREST

13.6.1 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

13.7 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

13.7.1 As between the Owner and Contractor:

.1 **Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statue of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

.2 **Between Substantial Completion and Final Certificate for Payment.** As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statue of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and

.3 **After Final Certificate for Payment.** As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statue of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor, for any of the following reasons:

.1 issuance of an order of a court or other public authority having jurisdiction;

.2 an act of government, such as a declaration of national emergency, making material unavailable;

.3 because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Subparagraph 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents;

.4 if repeated suspensions, delays or interruptions by the Owner as described in Paragraph 14.3 constitute in the aggregate more than 100 percent of the total number of days schedules for completion, or 120 days in any 365-day period, whichever is less; or

.5 the Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Subparagraph 2.2.1.

14.1.2 If one of the above reasons exists, the Contractor may, upon seven additional days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages.

14.1.3 If the Work is stopped for a period of 60 days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Subparagraph 14.1.2.

14.2 TERMINATION BY THE OWNER FOR CAUSE

14.2.1 The Owner may terminate the Contract if the Contractor:

.1 persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors.

.3 persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

14.2.2 When any of the above reasons exist, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate

employment of the Contractor and may, subject to any prior rights of the surety:

.1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 accept assignment of subcontracts pursuant to Paragraph 5.4; and

.3 finish the Work by whatever reasonable method the Owner may deem expedient.

14.2.3 When the Owner terminates the Contract for one of the reasons stated in Subparagraph 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.3.2 An adjustment shall be made for increases in the cost of performance of the Contract, including profit on the increased cost of performance, caused by suspension, delay or interruption. No adjustment shall be made to the extent:

.1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

14.3.3 Adjustments made in the cost of performance may have a mutually agreed fixed or percentage fee.

SECTION 00720

GENERAL CONDITIONS

The General Conditions of the Contract for Construction, A1A Document A201, Fourteenth Edition (1987), Articles 1-14 inclusive, is a part of this contract.

END OF SECTION

SECTION 00810

EXHIBIT A
SUPPLEMENTARY GENERAL CONDITIONS

THE GENERAL CONDITIONS

The "General Conditions of the Contract for Construction," AIA Document A201, Fourteenth Edition (1987), Articles 1 through 14 inclusive, is a part of this Contract.

THE SUPPLEMENTARY CONDITIONS

The following supplements modify and/or change, delete from and/or add to the General Conditions. Where any Article, Paragraph or subparagraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such Article, Paragraph, or subparagraph shall remain in effect and the supplemental provisions shall be considered as added thereto. Where any Article, Paragraph, or subparagraph in the General Conditions is amended, voided or superseded by any of the following paragraphs, the provisions of such Article, Paragraph or subparagraph not so amended, voided, or superseded shall remain in effect.

INDEX

ARTICLE I GENERAL PROVISIONS

A. Delete the fourth sentence in Subparagraph 1. 1.2 and substitute the following:

"Except as provided in Paragraph 3.18, this Contract Document shall create a contractual relationship solely between the owner and Contractor.

B. Delete Subparagraph 1.2. 1.

C. Add the following to the end of Subparagraph 1.2.3:

"All Work mentioned or indicated in the Contract Documents shall be performed by the Contractor as part of this Contract unless it is specifically indicated in the Contract Documents that such Work is to be done by others. The Documents should be viewed together as a complete entity and complimentary.

In case of conflicts between Drawings and specifications, or within either the Drawings or specifications, the Contractor shall provide the better quality or greater quantity of work and materials unless otherwise directed by written Addendum or Change Order to the Contract."

E. Add Subparagraphs 1.2.6 through 1.2.13 as follows:

1.2.6 Where codes, standards, requirements and publications of public and private bodies are referred to in the Specifications, references shall be understood to be to the latest revision prior to the date of receiving bids, except where otherwise indicated.

1.2.7 Test boring or soil test information included with the Contract Documents or otherwise made available to the Contractor was obtained by the Owner for use by the Architect in the design of the Project or Work. The Owner does not hold out such information to the Contractor as an accurate or approximate indication of subsurface conditions, and no claim for extra cost or extension of time resulting from a reliance by the Contractor on such information shall be allowed except as provided in Subparagraph 4.3.6.

ARTICLE 2 OWNER

A. Delete everything following the words "execution of the Agreement" in the last sentence in Subparagraph 2.1.2.

B. Delete Subparagraph 2.2.1.

C. Delete Subparagraph 2.2.4 and substitute the following:

2.2.4 Information or services required of the Owner hereunder shall be furnished by the Owner with reasonable promptness after receipt from the Contractor of a request for such information or services.

D. Delete Subparagraph 2.2.5 and substitute the following:

2.2.5 The Owner will supply the Contractor with one reproducible set of the Drawings and Specifications. The Contractor shall provide its Subcontractors with Contract Documents.

E. Add Subparagraph 2.2.7 as follows:

2.2.7 The Contractor shall be responsible for coordinating the schedule for testing which is mutually agreed upon by Owner, Architect and Contractor. The Owner shall be responsible for the employment of Independent Testing Laboratories (ITL).

The Contractor shall bear all costs for retesting done by the Independent Testing Laboratory (ITL) due to nonconforming work.

F. In the sixth line of Subparagraph 2.3. 1, after the word "may" add the following:

", after Contractor's receipt of a seven (7) day written notice and failure by Contractor to cure,".

G. Delete the first and second sentences of Subparagraph 2.4.1 and substitute the following:

"If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to begin and prosecute correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies."

H. In the third sentence in Subparagraph 2.4. 1, delete the fourth sentence.

ARTICLE 3 CONTRACTOR

A. Delete Subparagraph 3.2.1 and substitute the following:

3.2.1 Before starting the Work, and at frequent intervals during the progress thereof, the Contractor shall carefully review and compare the Contract Documents with each other and with the information furnished by the Owner pursuant to Subparagraph 2.2.2 and shall at once report to the Architect any error, inconsistency or omission the Contractor may discover. Any necessary change shall be ordered as provided in Article 7, subject to the requirements of Paragraph 1.2 and other provisions of the Contract Documents. If the Contractor proceeds with the Work without such notice to the Architect, having discovered such errors, inconsistencies or omissions, or if by reasonable review of the Contract Documents the Contractor could have discovered such, the Contractor shall bear all costs arising therefrom.

B. Add Subparagraph 3.2.4 and 3.2.5 as follows:

3.2.4 The Contractor shall give the Architect timely notice of any additional Drawings, Specifications, or instructions required to define the Work in greater detail or to permit the proper progress of the Work.

3.2.5 The Contractor shall not proceed with any Work not clearly and consistently defined in detail in the Contract Documents, but shall request additional drawings or instructions from the Architect as provided in Subparagraph 3.2.4. If the Contractor proceeds with such work without obtaining further Drawings, Specifications or instructions, the Contractor shall correct Work incorrectly done at the Contractor's own expense.

C. Delete the first sentence in Subparagraph 3.5.1 and substitute the following:

"The Contractor warrants that the materials and equipment furnished under the Contract will be new and of recent manufacture unless otherwise specified, and that all Work will be of good quality, free from faults and defects, and in conformance with the Contract Documents.

D. Delete the last two sentences in Subparagraph 3.5.1.

E. Add Subparagraphs 3.5.3 through 3.5.9 as follows:

3.5.3 In all cases in which a manufacturer's name, trade name or other proprietary designation is used in connection with materials or articles to be furnished under this Contract, whether or not the phrase "or equal" is used after such name, the Contractor shall furnish the product of the named manufacturer(s) without substitution, unless a written request for a substitute has been submitted by the Contractor and approved in writing by the Architect as provided in Subparagraph 3.5.4 and within the time limits and conforming to the procedures outlined in Section 01600 of the General Requirements.

3.5.4 If the Contractor proposes to use a material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the material is submitted for approval, and shall request written approval of the deviation from the requirements of the Contract Documents.

3.5.5 In requesting approval of deviations or substitutions, the Contractor shall provide, upon request, evidence leading to a reasonable certainty that the proposed substitution or deviation will provide a quality of result at least equal to that otherwise attainable. If, in the opinion of the Architect, the evidence presented by the Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.

3.5.6 The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible items of mechanical and electrical equipment have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of their suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve as equal to materials specified proposed substitutes which, in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Project. In order to permit coordinated design of color and finishes the Contractor shall, if required by the Architect, furnish the substituted material in any color, finish, texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.

3.5.7 Any additional cost, or any loss or damage arising from the substitution of any material or requirement for those originally specified shall be borne by the Contractor, notwithstanding approval or acceptance of such substitution by the Owner or the Architect, unless such substitution was made at the written request or direction of the Owner or the Architect.

3.5.8 The warranty provided in this paragraph 3.5 shall be in addition to and not in limitation of any other warranty required by the Contract Documents or otherwise prescribed by law.

3.5.9 The Contractor shall procure and deliver to the Architect, no later than the date claimed by the Contractor as the date of Substantial Completion, all special warranties required by the Contract Documents. Delivery by the Contractor shall constitute the Contractor's guarantee to the Owner that the warranty will be performed in accordance with the warranty's terms and conditions.

E. Delete Subparagraph 3.6.1 and substitute the following:

3.6.1 The Owner is a non-profit organization and is exempt from all sales, consumer, use and other similar taxes as provided by law. The Contractor, Subcontractors, sub-subcontractors, material and equipment suppliers and the like, providing taxable goods for incorporation into the Work shall take this into account, so that the Owner does not pay such taxes. Obtain rebates for any taxes incorrectly paid and reimburse the Owner in the full amount on a Change Order. The Owner will provide the necessary evidence and certificates of tax exemption on request for those concerned.

F. Add subparagraph 3.9.1.1 as follows:

"3.9.1.1 The Contractor shall provide and maintain a job site telephone and answering machine for use by the Project Superintendent/Manager.

G. Add Subparagraphs 3.9.2 through 3.9.5 as follows:

3.9.2 The Contractor shall retain a competent Registered Professional Engineer or Registered Land Surveyor, acceptable to the Architect, who shall establish the exterior lines and required elevations of all buildings and structures to be erected on the site and shall establish sufficient lines and grades for the construction of associated Work such as, but not limited to, roads, utilities and site grading. The Engineer or Land Surveyor shall certify as to the actual location of the constructed facilities in relation to property lines, building lines, easements, and other restrictive boundaries.

3.9.3 The Contractor shall establish the building grades, lines, levels, column, wall and partition lines required by the various Subcontractors in laying out their Work.

3.9.4 The Contractor shall coordinate and supervise the Work performed by Subcontractors to the end that the Work is carried out between trades and that no trade, causes delay to the general progress of the Work. The Contractor and all Subcontractors shall afford each trade, any separate contractor, or the Owner, reasonable opportunity for the installation of Work and the storage of materials.

3.9.5 The Contractor shall arrange for and conduct job meetings with the Architect and such other persons as the Architect may from time to time wish to have present. The Contractor shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Contractor's own superintendent. An authorized representative of any Subcontractor or Sub-subcontractor shall attend such meetings if the representative's presence is requested by the Architect. Such representatives shall be empowered to make binding commitments on all matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. All notices required under the Contract may be served on such representatives

H. Add Subparagraphs 3.10.4 and 3.10.5 as follows:

3.10.4 The Progress Schedule shall be based on an orderly progression of the Work, allowing adequate time for each operation (including adequate time for submission and review of submittals), and leading to a reasonable certainty of Substantial Completion by the date established in the Agreement. The Progress Schedule

will be reviewed by the Architect for compliance with the requirements of this Article and Section 01320 and will be accepted by the Architect or returned to the Contractor for revision and resubmittal.

3.10.5 If the Architect in agreement with the owner has determined that the Contractor should be permitted to extend the time for completion as provided in Paragraph 8.3, the Progress Schedule shall be adjusted accordingly, and the dollar value of Work to be completed as of the first of each month shall be recalculated.

I. Delete Subparagraph 3.12.7 and substitute the following:

3.12.7 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor thereby represents that the Contractor has or will have determined and verified all dimensions (including field dimensions), quantities, relationship to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, Product Data, Samples and similar submittals, and verification of compliance with an requirements of the Contract Documents. The accuracy of such information is the responsibility of the Contractor. In reviewing Shop Drawings, Product Data, Samples, and similar submittals, the Architect shall be entitled to rely upon the Contractor's representation that such information is correct and accurate.

J. Insert the following at the end of Subparagraph 3.12.9:

"Unless such written notice has been given, the Architect's approval of a resubmitted Shop Drawing, Product Data, Sample, or similar submittal shall not constitute approval of any changes not requested on the prior submittal."

K. Delete Subparagraph 3.12.11 and substitute the following:

3.12.11 When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Owner shall be entitled to rely upon such certifications, and neither the Owner nor the Architect shall be expected to make any independent examination with respect thereto.

L. In the second line of Subparagraph 3.15.2, after the word "Documents," insert the following:

"after reasonable written notice from the Owner of such failure,"

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

A. Delete Subparagraph 4.1.2.

B. Delete the second sentence in Subparagraph 4.2.7 and substitute the following:

"The Architect's action will be taken with reasonable promptness, while allowing sufficient time in the Architect's professional judgment to permit adequate review, taking into account the time periods set forth in the latest schedule prepared by the Contractor and reviewed by the Architect pursuant to Subparagraphs 8.2.4 through 8.2.10."

C. In Subparagraph 4.2.7, in the fifth sentence, delete the words "unless otherwise specifically stated by the Architect".

D. Insert the following at the end of Subparagraph 4.2.8:
"and Subparagraph 7.1.2. 1."

E. In Subparagraph 4.2.11, in the last sentence delete the words "15 days" and substitute the following:

"seven (7) days".

F. In Subparagraph 4.2.12 after the first sentence add the following:

"The Architect may, as the Architect judges desirable, issue additional drawings or instructions indicating in greater detail the construction or design of the various parts of the Work, such drawings or instructions may be affected by field order or other notice to the Contractor, and provided such drawings or instructions are reasonably consistent with the previous existing Contract Documents, the Work shall be executed in accordance with such additional drawings or instructions without additional cost or extension of the Contract Time. If the Contractor claims additional cost or time on account of such additional drawings or instructions, the Contractor shall give the notice provided in Subparagraph 4.3.7."

G. In Subparagraph 4.3.3, in the first sentence change "21 days" to "7 days".

At the end of the second sentence in Subparagraph 4.3.3, add the following:

"within 7 working days and quantification of the claims made within 15 working days."

Delete the last sentence in Subparagraph 4.3.3 and substitute the following:

"Any change or addition to a previously made claim shall be made by timely written notice in accordance with this Subparagraph 4.3.3."

H. In Subparagraph 4.3.6 change "21 days" to the following:

"seven (7) days".

After the fourth sentence add the following:

Written notice of the claim must be made within seven (7) working days with quantification of the claim submitted within 15 working days.

Delete Subparagraph 4.3.7 and substitute the following:

4.3.7 If the Contractor claims that any acts or omissions of the Owner or the Architect, including any instructions or orders, whether oral, written, by Drawings, or otherwise, involve extra cost or time, and the Contractor has not received a written acknowledgment by the Owner or Architect that extra payment will be made or time extended on account thereof, the Contractor shall promptly (but within seven (7) days) so notify the Architect in writing of such claim and shall not proceed with the Work relating to such claim until the Contractor has received a further written order to proceed in accordance with Paragraph 4.4 except, as provided in Paragraph 10.3, in the case of an emergency affecting life or property. No claim by the Contractor on account of such acts, omissions, instructions or orders shall be valid unless the Contractor has so notified the Architect, before proceeding, and has received the further written order to proceed.

"The Contractor shall have the burden of demonstrating the effect of the claimed delay on the Contract Time, and shall furnish the Architect with such documentation relating thereto as the Architect may reasonably require, demonstrating the change to the project end date due solely to the inclusion of the delaying activity."

L. Add the following to the end of Clause 4.3.8.2:

Delaying weather is extreme weather, as defined by the National Weather Service in Gray, Maine.

The contractor must consider weather in the schedule by adding durations to those activities which are weather dependant and occurs during seasons when weather may be an issue.

ARTICLE 5 SUBCONTRACTORS

A. Delete Subparagraph 5.4.2.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

A. Delete Subparagraph 6.2.5.

B. In Subparagraph 6.3.1 in the fifth line after the word "Owner" add the following:

"after written notice".

ARTICLE 7 CHANGES IN THE WORK

A. In Article 7 delete the words "a reasonable allowance for overhead and profit" wherever they occur and substitute the following:

"an amount for overhead and profit in accordance with the schedule set forth in subparagraph 7.3.3.2".

B. Add Clause 7.1.2.1 as follows:

7.1.2.1 The Architect may issue Bulletins. A Bulletin is either:

a) a clarification to the Contract Documents, in accordance with Subparagraph 4.212, or

b) a minor change in the Work in accordance with paragraph 7.4, or

c) proposed extra Work resulting in an adjustment to the Contract Sum and/or Contract Time.

Upon receipt of a Bulletin, the Contractor shall review it promptly; if a Bulletin is determined by the Contractor to be a clarification to the Contract Documents or a minor change in the Work, the Contractor shall proceed in accordance with Paragraph 7.4. If the Bulletin is determined by the Contractor to be extra Work resulting in an adjustment to the Contract Sum and/or Contract Time, the Contractor shall not proceed with the Work described in the Bulletin, unless specifically authorized to do so in writing, but shall submit a detailed estimate in accordance with new Subparagraphs 7.3.1.1 and 7.3.3.

C. Add Subparagraph 7.1.5 as follows:

In order to facilitate checking for quotations of extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over $600.00 be approved without such itemization.

D. Delete Subparagraph 7.2.2.

E. Add Clause 7.3.1.1 as follows:

7.3.1.1 Upon request of the Owner or the Architect, the Contractor shall without cost to the Owner submit to the Architect, in such form as the Architect may require, an accurate written estimate of the cost of any proposed extra Work or change. The estimate shall indicate the quantity and unit cost of each item of materials, and the number of hours of work and hourly rate for each class of labor, as well as the description and amounts of all other costs chargeable under the terms of this Article. Unit labor costs for the installation of each item of materials shall be shown if required by the Architect. The Contractor shall promptly revise and resubmit such estimate if the Architect determines that it is not in compliance with the requirements of this Article, or that it contains errors of fact or mathematical errors. If required by the Architect, in order to establish the exact cost of new Work added or of previously required Work omitted, the Contractor shall obtain and furnish to the Architect bona fide proposals from recognized suppliers for furnishing any material included in such Work. Such estimates shall be furnished promptly so as to occasion no delay in the Work, and shall be furnished at the Contractors expense. The Contractor shall state in the estimate any extension of time required for the completion of the Work if the change or extra work is ordered.

F. Delete Subparagraph 7.3.3 and substitute the following:

7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods, as selected by the Owner.

(a) By unit price stated in the Contract Documents or otherwise mutually agreed upon.

(b) By Cost and Percentages estimated by the Contractor as provided in Clause 7.3. 1.1 and accepted by the Owner; the Contractor's estimate shall become a fixed price which shall not be changed by any variation in the actual cost of executing the Work covered by the change.

(c) By actual Cost determined after the Work covered by the change is completed, plus Percentage.

G. Add Subparagraphs 7.3.3.1, 7.3.3.2, 7.3.3.3, and 7.3.3.4 as follows:

7.3.3.1 As used in this paragraph, 'Cost' shall mean the estimated or actual net increase or decrease in cost to the Contractor, Subcontractor, or Sub-subcontractor for performing the Work covered by the change, including actual payments for materials, equipment rentals, expendable items, wages and associated benefits to workmen and to supervisors employed full time at the site, insurance, bonds and other provable direct costs, but not including any administrative, accounting or expediting costs, or other indirect or overhead costs, or any wages or benefits of supervisory personnel not assigned full time to the site, or any amount for profit or fee to the Contractor, Subcontractor or Sub-subcontractor.

7.3.3.2 "Percentage" shall mean an allowance to be added to or subtracted from the cost in lieu of overhead and profit and of any other expenses which is not included in the Cost of the Work covered by the change, as defined above. When, in the reasonable judgment of the Architect, a series of Construction Change Directives

or Change Orders effect a single change, Percentage shall be calculated on the cumulative net increase or decrease in Cost, if any.

1. Percentage for a Sub-subcontractor shall be 10 percent of any net increase or decrease of Cost of any Work performed by the Sub-subcontractor's own forces plus 5 percent of any aggregate net increase in Cost of any work performed for the Sub-subcontractor by other contractors.

2. Percentage for a Subcontractor shall be 10 percent of any net increase or decrease of Cost of any Work performed by the Subcontractor's own forces plus 5 percent of any aggregate net increase in Cost of any work performed for the Subcontractor by other Sub subcontractors.

3. The Percentage for the Contractor shall be 10 percent of any net increase or decrease of Cost of any Work performed by the Contractor's own forces plus 5 percent of any net increase or decrease in the Cost for all other Work covered by the change.

7.3.3.3 If the Owner elects to determine the cost of the Work as provided in method (a) using unit prices stated in the Contract Documents or subsequently agreed upon, the unit prices shall be subject to Subparagraph 7.1.4. Notwithstanding the inclusion of unit prices in the Contract Documents, it shall be the Owner's option to require the Cost of any given change to be determined by one of the other methods stated in 7.3.3. If the owner elects to determine Cost of the change work by unit prices and the nature of the work is such that its extent cannot readily be measured after the completion of such work or any subsequent work, the Contractor shall keep daily records, available at all times to the Architect for inspection, of the actual quantities of such work put in place, and delivery receipts or other adequate evidence, acceptable to the Architect, indicating the quantities of materials delivered to the site for use in such unit price work, and distinguishing such from other similar material delivered for use in work included in the base Contract Sum. If so required by the Architect, materials for use in unit price work shall be stored apart from all other materials on the Project.

7.3.3.4 If the Owner elects to determine the cost of the Work as provided in methods (c) or (d) of Subparagraph 7.3.3 or if the method of determining the cost has not been established before the work is begun, the Contractor shall keep detailed daily records of labor and materials costs applicable to the work.

H. In Subparagraph 7.3.7 at the end of the second sentence, add the following:

"and agreed to by the Owner."

ARTICLE 8 TIME

A. Add Subparagraph 8.1.5 as follows:

"The term "working day" shall mean any calendar day except Saturdays, Sundays, and legal holidays at the jurisdiction of the Project." The Contractor shall provide the Owner 72 hours notice to work on Saturdays, Sundays and legal holidays and shall not proceed without Owner's approval.

B. Add Subparagraphs 8.2.4 through 8.2.10 as follows:

8.2.4 Promptly after award of the Contract, but prior to the second Application for Payment, the Contractor shall submit to the Architect a Progress Schedule as described in this Subparagraph and General Requirements Section 01320, "Submittals." The schedule shall show for each class of work included in the Schedule of Values, the percentage completion to be obtained and the total dollar value of work to be completed as of the first of each month until Substantial Completion. All calculations shall be on the basis of work in place, but not including the value of materials delivered but not in place.

C. In Subparagraph 8.3.1, Add the following to the end of Subparagraph 8.3.1:

"If the Contract Time is extended pursuant to this Subparagraph, such extension shall be the exclusive remedy of the Contractor, and said Contractor shall not be entitled to recover damages from the Owner, or the Architect."

D. Delete Subparagraph 8.3.3.

ARTICLE 9 PAYMENTS AND COMPLETION

A. In Subparagraph 9.1.1, change "total" in line two to "maximum."

B. In Subparagraph 9.2.1 in the first line delete the words "Before the first Application for Payment" and substitute the following:

"Promptly after award of the Contract but before the second Application for Payment"

Add at the end of the first sentence of Subparagraph 9.2. 1:

"and shall be revised if later found by the Architect to be inaccurate."

Add after the word "schedule" in the last sentence of Subparagraph 9.2.1:

"shall be coordinated with the progress schedule and".

C. Delete the first twelve words of the first sentence of Subparagraph 9.3.1 and substitute "At the time or times established in the Agreement". After the first sentence of Subparagraph 9.3. 1, add "The format and number of copies of such Applications for Payment shall be as directed by the Architect".

D. Delete Clause 9.3.1.1 and change Subparagraph 9.3.1.2 to 9.3.1.1

E. Add Subparagraphs 9.3.1.2, 9.3.1.3, as follows:

9.3.1.2 The Owner will pay 90 percent of the amount due the Contractor on account of progress payments.

9.3.1.3 The Owner shall make Progress Payments and Final Payment within 30 days of application date.

F. Add Subparagraph 9.3.4 as follows:

9.3.4 Each Application for Payment or periodic estimate requesting payment shall be accompanied by a waiver of liens from each Subcontractor and Contractor. Such waiver shall be in a form acceptable to the Owner.

G. In Subparagraph 9.5. 1, at the end of item 2. add the words:

"for which the Contractor is not entitled to a Claim as provided herein or which are not covered by insurance".

In Subparagraph 9.5.1, change item 6. and add new items 8. and 9. as follows:

"6. reasonable evidence that the Work will not be completed within the Contract Time,"

"8. a lien or attachment is filed contrary to Subparagraph 4.5.9; or

9. failure of mechanical trade or electrical trade subcontractors to comply with mandatory requirements for maintaining record drawings. The Contractor shall check record drawings each month. Written confirmation that the record drawings are current will be required by the Architect before approval of the Contractor's monthly payment requisition."

H. Delete Subparagraph 9.6.3.

I. Delete Subparagraph 9.6.4 and substitute the following:

9.6.4 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, Sub-subcontractor or material supplier.

J. Delete Subparagraph 9.6.5.

K. Add at the end of Subparagraph 9.8.1:

"and only minor items which can be corrected or completed without any material interference with the Owner's use of the Work remain to be corrected or completed."

L. Delete Subparagraph 9.8.2 and substitute the following:

9.8.2. When the Contractor considers that the Work, or a portion thereof designated in the Contract Documents for separate completion, is substantially complete and the premises comply with Subparagraph 3.15. 1, the Contractor shall submit to the Architect (1) a list of items to be completed or corrected, (2) all special warranties required by the Contract Documents, endorsed by the Contractor and in a form reasonably acceptable to the Architect and (3) the permits and certificates referred to in Subparagraph 13.5.4. The failure to include any items on the list mentioned in the preceding sentence does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract documents. When the Architect on the basis of an inspection determines that the Work or designated portion thereof is substantially complete and the other conditions have been met, the Architect will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate for Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

Delete Subparagraph 9.9.1 and substitute the following:

9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage. Such partial occupancy or use may begin whether or not the portion is substantially complete, provided that the respective responsibilities of the Owner and Contractor with respect to payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work, insurance, indemnification, correction of the Work, and warranties shall be established by agreement of the Owner and Contractor or, absent such agreement shall be determined by the Architect subject to the right of either party to contest such determination.

Delete the second sentence in Subparagraph 9.10.2 and substitute the following:

"If the Contractor fails to furnish such releases or waivers as the Owner reasonably requires to satisfy the Owner that there are no outstanding liens, the Owner may require the Contractor, as a condition of final payment and at the Contractor's expense, to furnish a bond satisfactory to the Owner to indemnify the Owner against any such liens."

At the end of Subparagraph 9.10.2 add the following:

"Final payment for a given Work Category constituting the entire unpaid balance for the Subcontract amount may be paid by the Owner to the Contractor following receipt of both the final Certificate for Payment from the Architect and the Final Lien Waiver from the Subcontractor and the Contractor. The Final Lien Waiver shall be submitted by the Subcontractor and Contractor on the form acceptable to the Owner. Final payments to the Subcontractor shall be made by Contractor after payment has been received by the Contractor.

P. Add Paragraph 9.11 as follows:

9.11 STORAGE OF MATERIALS OFF SITE

9.11.1 The Contractor, his Subcontractors, and Sub-subcontractors shall obtain prior written approval from the Owner for permission to store materials to be incorporated in the Work, for which Progress Payments will be requested, at off-site locations. Any and all charges for storage, including insurance, shall be borne solely by the Contractor. Before approval, Owner will require proper proof of insurance naming the Owner as an additionally insured party, and letter in which is furnished:

1. The name of the Contractor and/or Subcontractor or Subordinate Subcontractor leasing the storage area,
2. The location of such leased space,
3. The leased area: the entire premises of certain areas of a warehouse giving the number of floors or portions thereof,
4. The date on which the material is first stored,
5. The value of the material stored,
6. Transfer of Title to the Owner, Right of Entry and Removal.

9.11.2 The Contractor, his Subcontractors and Subordinate Subcontractors shall notify the Contractor and the Owner to inspect, at least once each month, the materials being stored at any location.

9.11.3 The Contractor, his Subcontractors and Subordinate Subcontractors shall mark each sealed carton with the name and address of the Project, the Contractor and Owner.

9.11.4 A perpetual inventory shall be maintained for all materials held in storage for which payment has been requested.

9.11.5 Payment for materials stored off site shall be at the sole discretion of the owner. Any additional costs to the Owner resulting from storage of material off site for which payment is requested, such as, but not limited to, travel expenses and time for inspectors, shall be backcharged to, and paid by, the Contractor.

9.11.6 Transfer of Title to the Owner, Right of Entry and Removal.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

A. Delete the words "asbestos and polychlorinated biphenyl (PCB's)" and the words "asbestos or polychlorinated biphenyl (PCB's)" in Subparagraphs 10.1.2, 10.1.3, and 10. 1.4 and substitute the words "unsafe materials"

B. Add Subparagraph 10.1.5

10.1.5 If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance encountered but not created on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. The Owner, Contractor and Architect shall then proceed in the same manner described in Subparagraph 10.1.2. The Owner shall be responsible for obtaining the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to verify that it has been rendered harmless.

C. Delete the word "and" at the end of the Clause 10.2.1.2.

D. Add the word "and" to the end of the Clause 10.2.1.3.

E. Add Clause 10.2.1.4 as follows:

10.2.1.4 Any other property of the Owner, whether or not forming part of the Work, located at the site or adjacent thereto in areas to which the Contractor has access.

F. In Subparagraph 10.2.5, in two places after the word "10.2.1.3", add the words ", and 10.2.1.4".

G. Add Subparagraphs 10.2.8 through 10.2.11 as follows:

10.2.8 During the progress of the Work and at all times prior to the date of Substantial Completion or occupancy of the Work by the Owner, whichever is earlier, the Contractor shall provide temporary heat, ventilation, and enclosure, adequate to permit the Work to proceed in a timely fashion, and to prevent damage to completed Work or Work in progress, or to materials stored on the premises. The permanent heating and ventilation systems may be used for these purposes when available.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

A. At the end of Subparagraph 12.2.2 add the following:

"For the purpose of establishing the guarantee period, the Date of Substantial Completion shall be deemed to occur when Certificates of Substantial Completion have been issued for all Work. In the case of Owner use and/or occupancy of a portion of the Work (including mechanical or electrical equipment) prior to completion of this phase of the Project, the guarantee period for said portion of Work shall commence upon the date of Owner occupancy."

ARTICLE 13 MISCELLANEOUS PROVISIONS

A. Add Subparagraph 13.2.2 as follows:

B. Delete Subparagraph 13.4.2 and substitute the following:

13.4.2 No consent or waiver, express or implied, by the Owner or the Architect to, or of, any breach of any covenant, condition or duty of the Contractor shall be construed as a consent to or waiver of any other breach of the same or any other covenant, condition or duty.

C. In the last sentence of Subparagraph 13.5.2, after the word "costs" add the following: "and changes to the Contract Time".

D. Delete Subparagraph 13.5.4 and substitute the following:

13.5.4 The Contractor shall obtain and deliver promptly to the Architect any occupancy permit and any certificates of final inspection of any part of the Contractor's work and operating permits for any mechanical apparatus, such as elevators, escalators, boilers, air compressors, etc., which may be required by law to permit full use and occupancy of the premises by the Owner. Receipt of such permits or certificates by the Architect shall be a condition precedent to Substantial Completion of the Work.

E. Delete Paragraph 13.7.

F. Add Paragraph 13.8 as follows:

13.8 EQUAL OPPORTUNITY

13.8.1 The Contractor shall maintain policies of employment as follows:
1. The Contractor and his Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. 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 setting forth the policies of non-discrimination.

2. The Contractor and his Subcontractors shall, in all solicitations for advertisements for employees placed by them or on their behalf; state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

H. Add Paragraph 13.9 as follows:

ARTICLE 14 TERMINATION OF THE CONTRACT

A. In Subparagraph 14.1.2 in the first fine delete the word "above, and after the word "exists" add the following:

"it as stated in Subparagraph 14.1.1,".

In Subparagraph 14.1.2 in the fourth line after the word "executed" add the following:
"termination and cancellation costs, "

B. In Subparagraph 14.2.2 in the first sentence delete the words "above" and "upon certification by the Architect that sufficient cause exists to justify such action".

In Subparagraph 14-2.2 in the first line after the word "exist" add the following:

"as stated in Subparagraph 14.2. 1, ".

C. Delete Paragraph 14.3 and substitute the following:

14.3 TERMINATION BY THE OWNER FOR CONVENIENCE

14.3.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

14.3.2 Upon receipt of written notice from the owner of such termination for the Owner's convenience, the Contractor shall:

1. Cease operations as directed by the Owner in such notice;

2. Take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

3. Except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

14.3.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment from the Owner on the same basis provided in Subparagraph 14.1.2.

Add ARTICLE 15 - OTHER CONDITIONS OF THE CONTRACT

15.1 Typographical errors in application for Payments or Change Orders shall not be grounds for additional payments.

15.2 If Section 952 of the Omnibus Reconciliation Act of 1980 is found to apply to this contractual relationship, it is agreed that the following Access to Records provision applies.

1. Until the expiration of four years after the furnishing of the services provided under this Contract, the Contractor will make available to the Secretary, U. S. Comptroller General, and their representatives, this Contract and all books, and documents and records necessary to certify the nature and extent of the costs for those services. If the Contractor carries out the duties of the Contract through a subcontract worth $10,000.00 or more over a twelve month period with a related organization the subperiod will also contain the access clause to permit access by the Secretary, Comptroller-General, and their representative to the related organization's books and records.

15.3 It is the intent of the parties hereby to comply with the provisions of Section 1861(v) (1) (1) of the Social Security Act.

END OF SECTION

SECTION 00835

CERTIFICATE OF SUBSTANTIAL COMPLETION OF WORK

OWNER'S Project No._____ ARCHITECT'S Project No. _____

Project: Riverton Expansion and Renovation

CONTRACTOR _____ Contract Date _____

Contract for Riverton Expansion and Renovation Project

Project or Specified Part Shall Include _____

DEFINITION OF SUBSTANTIAL COMPLETION

The date of Substantial Completion of a Project or specified part of a Project is the date when the construction is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part of the Project can be utilized for the purpose for which it was intended.

To: City of Portland, Maine

And To _____
(CONTRACTOR)

Date of Substantial Completion _____

The Work performed under this contract has been inspected by authorized representatives of the OWNER, CONTRACTOR and ARCHITECT, and the Project is hereby declared to be substantially completed on the above date.

A tentative list of items to be completed or corrected is appended hereto. The failure to include an item on it does not alter the responsibility of the CONTRACTOR to complete all the Work in accordance with the Contract Documents.

City of Portland	
OWNER	AUTHORIZED REPRESENTATIVE DATE
Semple & Drane Architects	
ARCHITECT	AUTHORIZED REPRESENTATIVE DATE

The CONTRACTOR accepts the above Certificate of Substantial Completion and agrees to complete and correct the items on the tentative list.

CONTRACTOR	AUTHORIZED REPRESENTATIVE	DATE

EXCEPTIONS AS TO GUARANTEES AND WARRANTIES:

ATTACHMENTS:

END OF SECTION

SECTION 00836

CERTIFICATE OF FINAL COMPLETION OF WORK

CONTRACT NO. _____ AGREEMENT DATE _____

CONTRACT DESCRIPTION: Riverton Expansion and Renovation Project

FINAL COMPLETION DATE PER AGREEMENT AND CHANGE ORDERS _____

FINAL CERTIFICATION OF CONTRACTOR

I hereby certify that the Work as identified in the Final Payment Request for construction Contract Work dated _____, represents full compensation for the actual value of Work completed. All Work completed conforms to the terms of the Agreement and authorized changes.

_____ _____
Date CONTRACTOR

_____
Signature

_____
Title

FINAL CERTIFICATION OF ARCHITECT

I have reviewed the CONTRACTOR'S Final Payment Request dated _____ and hereby certify that to the best of my knowledge, the cost of the Work identified on the Final Estimate represents full compensation for the actual value of Work completed and that the Work has been completed in accordance with the terms of the Agreement and authorized changes.

_____ SEMPLE & DRANE – ARCHITECTS
Date ARCHITECT

_____
Signature

_____
Title

FINAL ACCEPTANCE OF OWNER

I, as representative of the OWNER, accept the above Final Certifications and authorize Final Payment in the amount of $_____ The guaranty for all Work completed subsequent to the date of Substantial Completion, expires one (1) year from the date of this Final Acceptance.

_____ City of Portland
Date OWNER

_____
Authorized Representative

_____
Signature

END OF SECTION

SECTION 00837

WAIVER OF LIEN
MATERIAL OR LABOR

State of _____

County of _____

To all whom it may concern:

Whereas _____ the undersigned _____
has been employed to furnish for the project known as Riverton Expansion and Renovation

City of Portland County of Cumberland
State of Maine.

Know then for know ye that _____ the undersigned for

_____ and in consideration of the sum of

$ _____ and other good and valuable consideration the receipt

whereof is hereby acknowledged, do hereby waive and release from any and all, or claim the

right to lien on said above described project under the status of the State of _____.

Relating to Mechanic's Lien on account of Labor or Material or both furnished or which may be

furnished by the undersigned to or on account of said _____ for said

building and premise.

Given under _____ my hand and seal this _____ day

of_____, 20_____.

Notarized: _____ this _____ day of _____, 20____

My commission expires _____.

SECTION 00840

SPECIAL CONDITIONS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

1. Project Timeframe:

Bids will be received on this project May 25, 2006. The intent of this project is to

. The contract time is spelled in the contract documents.

2. Construction Schedule:

3. Vehicle Traffic Control and Access:

4. Safety Summary

5.1 The Contractor shall assume full responsibility and liability for compliance with all applicable standards and regulations pertaining to accident prevention, life, health and safety of all persons on the construction site, as well as the preventing damage to materials, supplies, and equipment. The Contractor will hold the City harmless for any action, error, or omission on the Contractor's part, by the Contractor's employees or the Contractor's subcontractors that result in illness, injury or death.

The Contractor shall coordinate activities so as to ensure and identify specific operations that must be performed in accordance with special safety requirements and standards. Specific operations include, but are not limited to, the following:

Erection, inspection and maintenance of hand rails, barricades, nets, scaffolds, shoring, and warning signs.

Shoring and sheeting or sloping excavations, including the lighting and barricading of excavations that traverse or run parallel to roads or streets and that may thereby constitute a hazard to pedestrians and vehicular traffic.

Training and use of signalmen.

Certification of machine and equipment operators.

Ensure adequate sanitary facilities. Determine employee's physical qualification to assume their assigned duties.

5.2 The Contractors responsibilities:

The Contractor is responsible for the safety of all persons exposed to the site operation.

The Contractor shall provide first aid materials and resources, and shall post emergency phone numbers and procedures for the treatment of personnel in a conspicuous place. In addition, the Contractor shall clearly identify and maintain fire lanes and emergency exit routes. Further, the Contractor shall provide fire prevention plans and equipment along with the training of personnel in the use of said plans and equipment.

The Contractor shall provide personal protective equipment such as hardhats, eye protection, ear protection, etc., to personnel as required.

The Contractor shall also be responsible for general housekeeping and associated removal of trash that could possibly contribute to a safety hazard.

The Contractor shall provide proof of manufacturer's warranties and/or inspection for all equipment to be utilized on the job site prior to its being made operational.

5.3 Accident investigation and reporting:

The Contractor shall report all accidents resulting in disabling or fatal injuries along with those involving damage to property, materials, supplies and/or equipment. A standard form will be furnished to the Contractor along with instructions on how to prepare and submit a report for each reportable accident occurring on the project site.

5.4 Normal airport operations will be conducted on the airfield during construction and the work shall be performed in such a manner as not to interfere with the necessary operation of the airport. The Contractor shall take all precautions necessary to ensure the safety of operating aircraft as well as his/her own equipment and personnel.

5. Security Requirements

END OF SECTION

CITY OF PORTLAND, MAINE
CONSTRUCTION CONTRACT AMENDMENT

PO #: 0

PROJECT NAME: xx — AMENDMENT: 0

CONTRACTOR: xx — CURRENT DATE: 1/0/1900

FUNDING ACCOUNT(S): xx — PROJECT #: 0

DESCRIPTION AND REASON FOR AMMENDMENT:

PRICING: (if items are outside the contract, indicate "agreed price")

Contract Item #	Unit Price	Quantity	Total

TOTAL AMOUNT $ -

PFC El.

Non-PFC

Has work been started? _____ (should only apply to emergencies)

If yes, has it been completed? _____ On (date): _____

AMOUNT OF ORIGINAL CONTRACT: $ -

TOTAL PREVIOUS AMENDMENTS: + $ -

AMOUNT OF THIS AMENDMENT: + $ -

TOTAL AMENDED CONTRACT TO DATE: = $ -

RECOMMENDED BY: **ACCEPTED BY:**

Project Manager	Date	Contractor	Date

AUTHORIZED BY:

Dept. Head or Div. Mgr.	Date	Dept. Financial Officer	Date
Budget/Purchasing Director	Date	City Manager	Date

Original – Dept. (to encumber) Yellow – Dept. (file) Pink – Purchasing Golden – Contractor

SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Owner-furnished products.
6. Use of premises.
7. Owner's occupancy requirements.
8. Specification formats and conventions.

B. Related Sections include the following:
1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: The City of Portland has planned for additions and renovations to the Riverton Elementary School and Community Center, a locally funded school project including selective demolition and removal of a portable classroom structure, and all necessary site improvements.
1. Project Location: 1600 Forest Avenue, Portland, Maine.

B. Owner: City of Portland, 389 Congress Street, Portland, Maine; attention Matthew F. Fitzgerald, Purchasing Agent.

C. Designer: Semple & Drane Architects, P.A., 496 Congress Street, Portland, Maine 04101. Phone: 207-761-4231 Fax: 774-0152 E-Mail: sdrane@maine.rr.com

D. The Work consists of a two additions to the building, infrastructure, utilities, and site improvements.
1. The Work includes the construction of a new single story structure housing a classroom, resource rooms and offices; a new single story structure housing a Parks and Recreation Department multipurpose space, Portland Health Department offices; window replacement; mechanical upgrades in classrooms; renovations to the existing school administration area; renovations to create a "Discovery" room and a new main entrance canopy. The building construction includes concrete foundations and slabs, veneer masonry walls, structural steel, steel joists, metal roof deck, architectural woodwork, waterproofing, insulated single ply membrane roofing, sheet metal, concrete masonry

interior walls, metal stud and gypsum wall board interior walls, wood doors, hollow metal doors and frames, aluminum entrances, aluminum windows, hardware, glazing, interior finishes, interior casework, plumbing, fire-protection, heating - ventilating and air-conditioning upgrades, electrical systems, lighting, technology systems, and communication - alarm - signal systems.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

B. The form of general construction contract shall be as defined and presented in "Contract Agreement (Public School Project), General Conditions of the Contract For Construction, and Section 00810 Exhibit A Supplementary General Conditions."

1.5 WORK PHASES

A. The Work shall be conducted in a series of phases that sequence the work while the building is fully occupied by the Owner. Completion of all phases of the project shall be substantially complete by the date defined below:
   1. Substantially Complete and ready for occupancy **no later than August 15, 2007.**

B. The Phasing is defined within Section 01100 Appendix A which is attached to the end of this section.

C. For each phase access to the building is highly restricted to those areas of the buildings shown on the phasing drawings. Requirements for temporary dust control and protection of those areas occupied are defined in Section 01500 Temporary Facilities.

D. At the completion of each phase the area of the building worked in will be cleaned and ready for Owner occupancy in accordance with the requirements defined in Section 01770 Project Closeout.

E. Before commencing the Project, submit a schedule showing the phasing, sequence, commencement and completion dates, and acceptance and/or move-in dates of Owner's personnel for the Work.

1.6 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
   1. Furniture Installation: A separate contract will be awarded to a School Furnishings Vendor for the contract to supply and install movable furnishings and education equipment provided the District as a separately funded component of this Project.

1.7 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated herein. The Work includes providing support systems to receive Owner's equipment, installation thereof where indicated, and making plumbing, mechanical, and electrical connections where applicable.
   1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
   2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
   3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
   4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
   5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
   6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
   7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Designer noting discrepancies or anticipated problems in use of product.
   8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
   9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
   10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
   11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

B. Owner-Furnished, Contractor Installed (OFCI) Products:
   1. Owner will furnish Paper Towel Dispensers, Toilet Paper Holders, and Soap Dispensers.
   2. Owner supplied compressor for dental operatory chair.
   3. Owner supplied dental operatory chair.
   4. Refrigerators.

1.8 USE OF PREMISES

A. General: Contractor will have limited use of premises for construction operations, including use of Project site, during construction period.

B. Use of Site: Limit use of and impact to project site area to the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. Maintain emergency and service/delivery access to back of building at all times.

C. Ordinance Compliance: City of Portland's Municipal Ordinances for all aspects of demolition and construction activities shall be fully complied with by all parties to the Contract. Stoppage of work by Local Authority mandate due to noncompliance will not be cause for claims or cost changes. Activity regulations include but may not necessarily be limited to the following:
   1. Noise thresholds for exterior and interior activities.
   2. Dust control and odor emanating from any on-site activities.

D. Hours of operations for exterior work, 7a.m. to 7 p.m.

1.9 OWNER'S OCCUPANCY REQUIREMENTS

A. Owner Occupancy of Facility During Construction: The City of Portland will occupy the facility during the construction period.
   1. The Riverton Elementary School will be in full operation with over 400 K – 5th grade students on site, from 9AM to 3 PM. Buses will be delivering and picking up students at the beginning and end of every school day. A schedule of the school year is available online at http://www.portlandschools.org/Pages/Community/schoolCalendar.html.
   2. The Portland Parks and Recreation department will be offering after school care, summer camps, and other events throughout the year at the facility.
   3. The project phasing is designed to accommodate the Owner Occupancy requirements.

B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
   1. Designer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
   3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
   4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.
   1. Division 1: Sections in Division 1 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. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. 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.

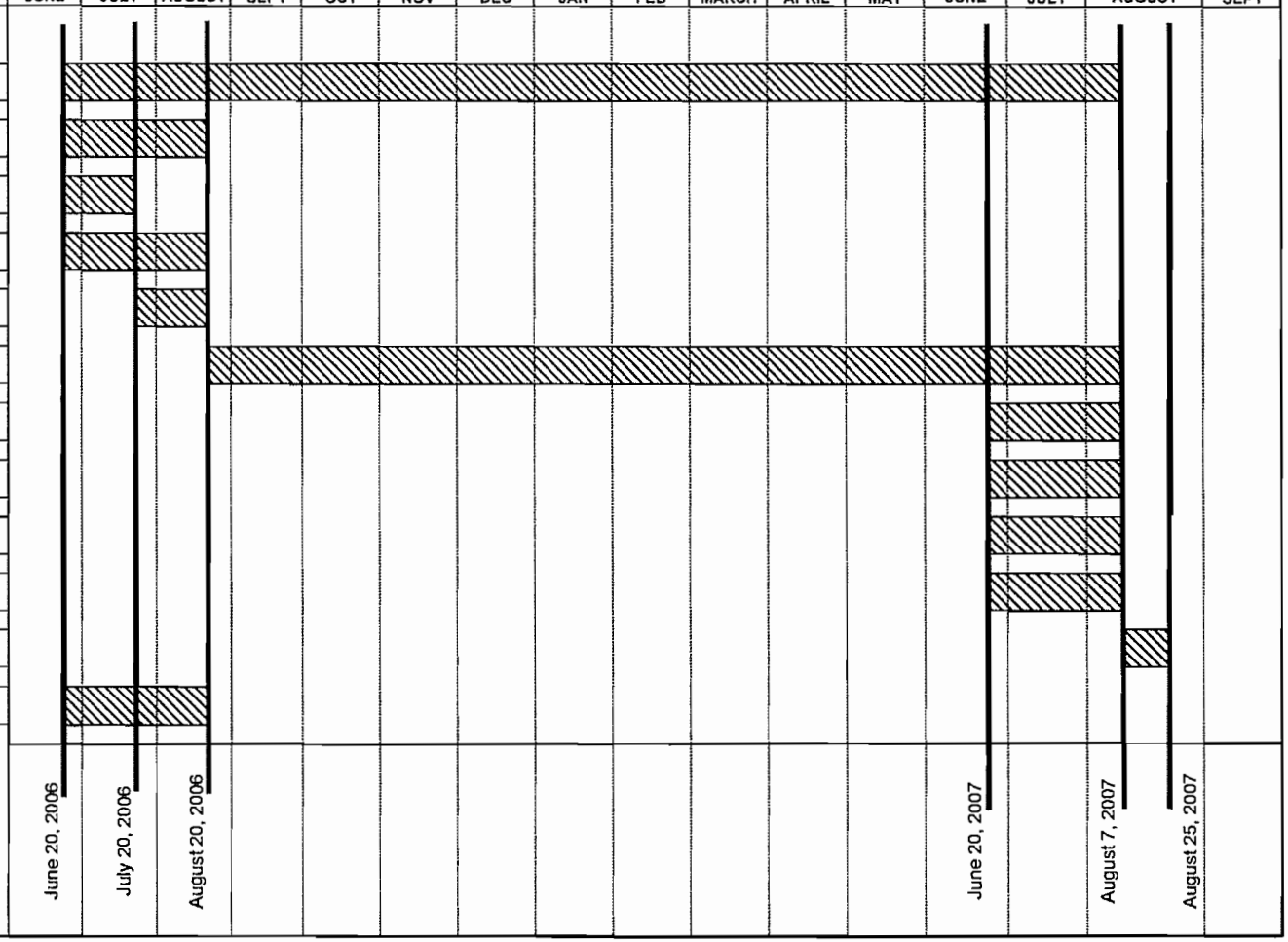
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

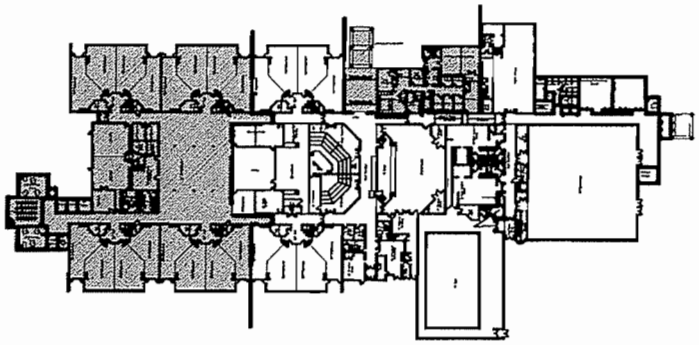
Phasing

PHASE	DESCRIPTION OF WORK	ROOMS
1	CLASSROOM ADDITION	A101 THRU A109
2	SCHOOL ADMINISTRATION RENOVATIONS	C100 thru C121
3	MECHANICAL CLASSROOM WORK	101 THRU 104, 201 THRU 204, 401 THRU 404, 501 THRU 504
4	MAIN ENTRANCE CANOPY FOUNDATIONS	
5	MECHANICAL CLASSROOM WORK	301 THRU 304, 601 THRU 604
6	COMMUNITY ADDITION	B101 THRU B117
7	EXISTING WINDOW REPLACEMENT	WHOLE BUILDING
8	GYM TOILET	E101
9	FAMILY LOCKER ROOM	E102, E103
10	DISCOVERY ROOM	D100
11	COMMISSIONING	WHOLE BUILDING
12	ALTERNATE 4 - LIBRARY CARPET	

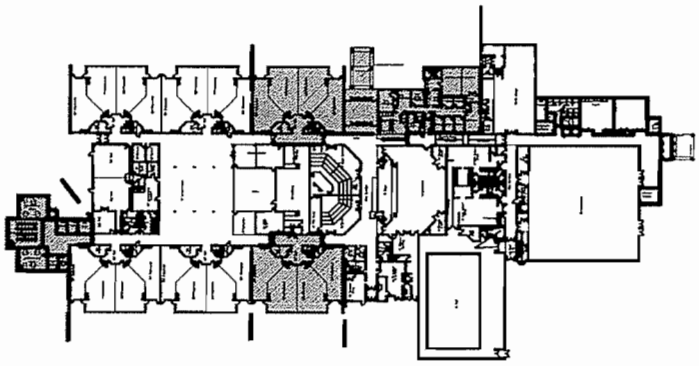


OWNER OCCUPIED

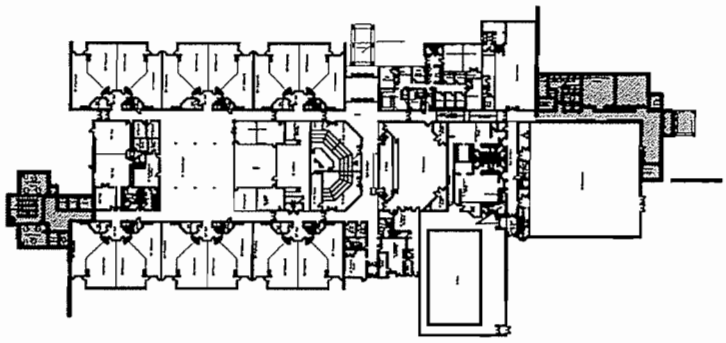
AVAILABLE FOR CONSTRUCTION



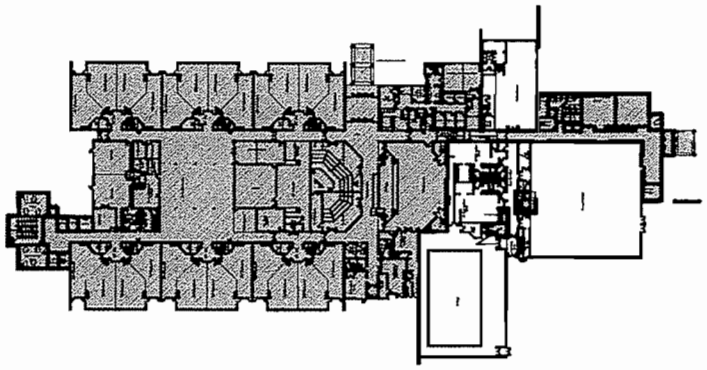
JUNE 20, 2006 TO JULY 20, 2006



JULY 20, 2006 TO AUGUST 20, 2006



AUGUST 20, 2006 TO JUNE 20, 2007



JUNE 20, 2007 TO AUGUST 7, 2007

SITE ACCESS - SEE SITE PLANS FOR ADDITIONAL PHASING REQUIREMENTS
MECHANICAL PLANS HAVE ADDTIONAL PHASING REQUIREMENTS

SECTION 01210 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date or to establish an anticipated cost for undefined scope of services, until additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Lump-sum allowances.

C. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
   2. Division 1 Section "Alternates" for alternate bids that allowance is a part of.
   3. Divisions 2 through 16 Sections for items of Work covered by allowances as identified in the Schedule of Allowances herein.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Designer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Designer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Designer from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM and UNIT-COST ALLOWANCES

A. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Lump Sum Allowance No. 1: As a part of the Alternate 5 Fire Protection, include the following amount in their Bid, for Fire Alarm system upgrades: **Allow a lump-sum of $50,000.00.**

END OF SECTION 01210

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates scheduled at the end of this Section.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
   2. If alternate work is accepted within 90 days of the Award of Contract, it shall be incorporated into the Project by Change Order and no additional costs beyond the proposed amounts carried on the Bid Form are applicable, including overhead, profit, or subcontractors' mark-up.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - SCHEDULE OF ALTERNATES

4.1 ALTERNATE NO. 1 (HVAC): Part A: Add new VAV terminals (less reheat coils), new ductwork, supply diffusers and additional controls work (VAV controllers were installed in a prior phase) within each classroom as shown in Drawings and Specifications as "Alternate 1". Part B: Clean AHU-9 (Café) supply and return ductwork as shown in Drawings and Outlined in Specifications as "Alternate 1".

4.2 ALTERNATE NO. 2 (Landscaping): Add 24 deciduous trees, 12 evergreen trees, and 64 shrubs. Provide all necessary materials and labor for planting as shown on Drawings and as specified as "Alternate 2".

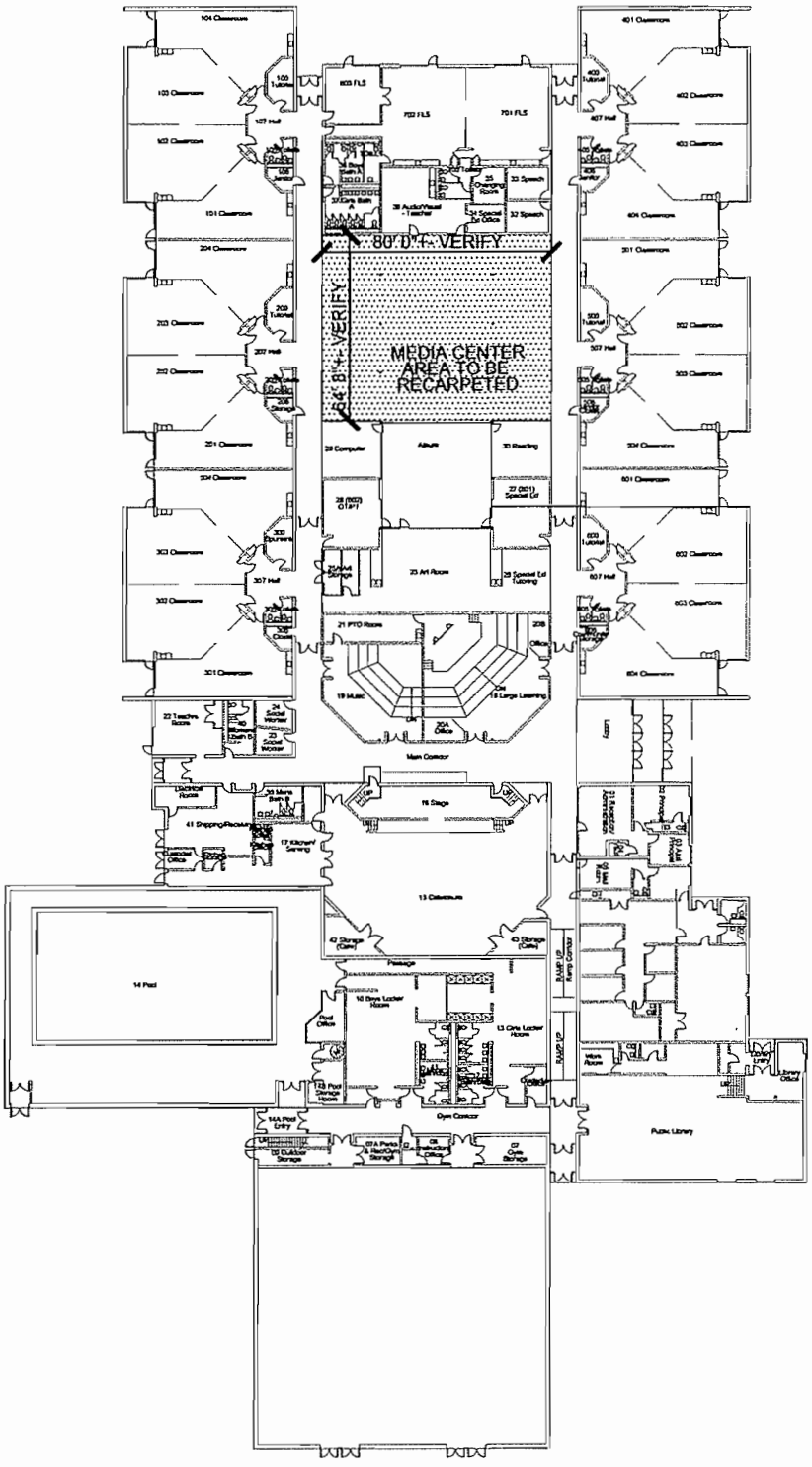
4.3 ALTERNATE NO. 3 (AHU-7 & 8 and Chiller System) Part A: Remove (E) AHU-7 & AHU-8 and replace with new units sized at existing conditions. This work includes associated piping and ductwork modifications as well as controls upgrades as shown in Drawings and Specifications as "Alternate 3". Part B: Remove (E) Compressor Chiller, (E) Air Cooled Condenser Unit, and (E) Chilled Water Pump and replace with new units sized at existing conditions. This work includes associated piping and ductwork modifications as well as controls upgrades as shown in Drawings and Specifications as "Alternate 3".

4.4 ALTERNATE NO. 4 (Library Carpet): Add to replace library carpet where shown on Drawings and as defined in the specifications as "Alternate 4. Price shall include removal and disposal of existing carpeting.

4.5 ALTERNATE NO. 5 (Fire Protection): Add throughout the entire building a complete sprinkler system (portion of the building has current coverage). Modify classroom window replacements, delete fire doors where shown to be deleted in this alternate, and make other changes throughout the facility permitted or necessitated by the sprinkler installation, as defined on the Drawings and specified as "Alternate 5".

4.4 ALTERNATE NO. 6 (Canopy Skylights): Add canopy skylights at the new school main entrance and the community entrances as shown on Drawings and specified as "Alternate 6".

END OF SECTION 01230


80'-0"+- VERIFY
84'-8"+- VERIFY
MEDIA CENTER
AREA TO BE
RECARPETED

SECTION 01250 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:
1. Contract Forms Section "General Conditions and Contract for Construction", Article 7 in particular for procedures for Changes in the Work.
2. Section 00810 "Exhibit A Supplementary General Conditions", modifications to Article 7 in particular.
3. Division 1 Section "Allowances" for procedural requirements for handling and processing allowances.
4. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Designer 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, "Designer's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Designer 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. Proposal Requests issued by Designer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 10 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 including applicable delivery charges, equipment rental, and amounts of trade discounts or credit directly attributable to the change.
   b. Include costs of labor and supervision directly attributable to the change.
   c. 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.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Designer.

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 including applicable delivery charges, equipment rental, and amounts of trade discounts.
3. Include costs of labor and supervision directly attributable to the change.
4. 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.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests unless another form has been accepted and approved by all parties to the Contract prior to issuance of first request.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Change Proposal from Contractor, Designer will issue a Change Order for signatures of Owner, Department of Education, Bureau of General Services, Designer, and Contractor on Maine Bureau of General Services form BGS 18-57.
1. Electronic version of Form is available upon request.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Designer 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 01250

SECTION 01290 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
1. Contract Forms Section "General Conditions and Contract for Construction", Article 9 in particular for procedures for Payment for the Work.
2. Section 00810 "Exhibit A Supplemental General Conditions", modifications to Article 9 in particular.
3. Division 1 Section "Allowances" for procedural requirements governing handling and processing of allowances.
4. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
5. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement from the Contractor allocating portions of the Contract Sum to various portions of the Work which shall be used as the basis for reviewing monthly Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
1. Correlate 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. Contractor's Cost-loaded CPM Construction Schedule.
2. Submit the Schedule of Values to Designer at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the AIA format as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. 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. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
h. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

2. 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 several line items for principal subcontract amounts, where appropriate.
3. 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.
4. Allowances: Provide a separate line item in the Schedule of Values for each allowance. 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.
5. 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 shall be consistent with previous applications and payments as certified by Designer 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. Payment Application Forms: Obtain and use the AIA forms for "Requisition for Payment" or approved facsimile 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. Designer 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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 6 signed and notarized original copies of each Application for Payment to Designer by a method ensuring receipt not later than 24 hours prior to requisition meeting. One copy shall include waivers of lien and similar attachments as required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   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 final or full waivers.
   3. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   4. Waiver Forms: Submit waivers of lien on forms included.

G. 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.
   2. Contract Cost Breakdown.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Performance and payment bonds.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: 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.
   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 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01310 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General project coordination procedures.
   2. Material, environmental, and labor conservation.
   3. Administrative and supervisory personnel.
   4. Coordination Drawings.
   5. Project meetings.
   6. Requests for Interpretation (RFIs).

B. Related Sections include the following:
   1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
   2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 COORDINATION

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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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 if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors 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 the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems including coordination with Commissioning Authority.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of labor, energy, water, and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 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.
   1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate required installation sequences.
      c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Designer for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   2. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections, particularly Divisions 13, 15 and 16.

B. 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 and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys 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.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work, including Safety and Quality Control personnel.

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 Designer of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Provide notes of significant discussions and agreements achieved for Designer to incorporate in minutes(s) he shall prepare for the Record. Designer will distribute the meeting minutes to everyone concerned, including Owner and Contractor, within 5 working days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Designer and BGS, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. Attendees: Authorized representatives of Owner, BGS, Designer, 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. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing and inspecting.
      h. Procedures for processing Applications for Payment.
      i. Distribution of the Contract Documents.
      j. Submittal procedures.
      k. Preparation of Record Documents.
      l. Use of the premises.
      m. Work restrictions.
      n. Owner's occupancy requirements.
      o. Responsibility for temporary facilities and controls.
      p. Construction waste management and recycling.
      q. Office, work, and storage areas.
      r. Equipment deliveries and priorities.
      s. First aid.
      t. Security.
      u. Progress cleaning.
   3. Minutes: Designer will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction, as specifically indicated in designated Sections of the Project Manual including but not limited to the following;
   1. Meetings shall be required for the following construction activities whether specified in their respective Specification Sections or not.
      a. Masonry

b. Roofing
c. Building Insulation
d. Glazing
e. Gypsum Drywall and Light Gage Metal Framing
f. Flooring

2. 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 Designer of scheduled meeting dates.
3. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. The Contract Documents.
   b. Options.
   c. Related RFIs and Change Orders.
   d. Purchases.
   e. Deliveries.
   f. Submittals.
   g. Review of mockups.
   h. Possible conflicts or Compatibility problems.
   i. Time schedules.
   j. Weather limitations.
   k. Manufacturer's written recommendations.
   l. Warranty requirements.
   m. Acceptability of substrates.
   n. Temporary facilities and controls.
   o. Space and access limitations.
   p. Regulations of authorities having jurisdiction.
   q. Testing and inspecting requirements.
   r. Coordination with other work.
   s. Required performance results.
   t. Protection of adjacent work, construction and personnel.
4. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions listing parties responsible or tasked.
5. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
6. 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. Progress Meetings: Conduct progress meetings at not less than monthly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Designer, each contractor, 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. 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) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Field observations including Owner and Designer concerns.
14) Status of proposal requests, Pending changes and Change Proposals.
15) Status of Change Orders, RFIs, and Construction Change Directives.
16) Pending claims and disputes.
17) Documentation of information for payment requests.

3. Minutes: Designer will record and distribute to Contractor the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   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.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
   1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
   1. RFI number, numbered sequentially.
   2. Specification Section number and title and related paragraphs, as appropriate.
   3. Drawing number and detail references, as appropriate.
   4. Field dimensions and conditions, as appropriate.
   5. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   6. Contractor's signature.
   7. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: Format shall be industry standardized model acceptable to all parties. Identify each page of attachments with the RFI number and sequential page number.

D. Designer's Action: Designer will review each RFI, determine action required, and return it. Allow seven working days for Designer's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
   d. Requests for adjustments in the Contract Time or the Contract Sum.
   e. Requests for interpretation of Designer's actions on submittals.
   f. Incomplete RFIs or RFIs with numerous errors.
2. Designer's action may include a request for additional information, in which case Designer's time for response will start again.
3. Designer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Designer in writing within 10 working days of receipt of the RFI response.

E. On receipt of Designer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Designer within seven working days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. RFI number including RFIs that were dropped and not submitted.
2. RFI description.
3. Date the RFI was submitted.
4. Date Designer's response was received.
5. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01320 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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. Submittals Schedule.
   3. Material location reports.

B. Related Sections include the following:
   1. Division 1 Section "Summary of Work" for project phasing requirements.
   2. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
   3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 1 Section "Closeout Procedures" for submitting specified or approved photographic or video-graphic materials as Project Record Documents or required Owner Training at Project closeout.

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 activities are activities on the critical path. They 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 Designer.

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. Fragnet: 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.

1.4 SUBMITTALS

A. Submittals Schedule: Submit four (4) copies of schedule. Arrange the following information in a tabular format:
1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Designer's final release or approval.

B. Contractor's Construction Schedule: Submit four (4) opaque copies of initial schedule, large enough to show entire schedule for entire construction period. Two copies shall be in color where necessary to easily identify icons employed by software used in development of schedule to facilitate interpretation.

C. Material Location Reports: Submit four (4) copies at monthly intervals.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. Initial Submittal: Submit concurrently with preliminary network diagram. Include submittals required during the first 60 days of construction. List those 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.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
   1. Indicate Project Phasing.
   2. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Designer.
   2. Procurement Activities: Include procurement process activities for the following 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.
      a. HVAC Equipment.
      b. Electric service entrance equipment and switchgear.
      c. Fabricated steel framing system.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   4. Startup and Testing Time: Include not less than 25 working days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Designer's administrative procedures necessary for certification of Substantial Completion.

D. 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Work Restrictions: Show the effect of the following items on the schedule:
   a. Use of premises restrictions.
   b. Provisions for future construction.
4. Work Stages: Indicate important stages of construction for each major portion of the Work.
5. Area Separations: 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. Permanent space enclosure.
   c. Completion of mechanical installation.
   d. Completion of electrical installation.
   e. Operational fire protection system.
   f. Substantial Completion.
   g. Final cleaning.

E. Milestones: Include milestones for phases of construction indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

G. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within ten (10) working days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, 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.
   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 Designer'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. Include list of nonworking days and holidays incorporated into the schedule.

B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary 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 testing and commissioning.
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.

C. 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.

D. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site including dates of delivery. Reports shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE
1. Scheduling Capabilities: Should the Contractor not have under their employ, skilled personnel with experience in CPM scheduling and reporting techniques, he shall engage an experienced consultant.

B. 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 prequisition 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.

C. Distribution: Distribute copies of approved schedule to Designer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. 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 01320

SECTION 01330 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:
1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
5. Division 1 Section "Closeout Procedures" for submitting warranties.
6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Division 1 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
9. Divisions 2 through 16 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Designer's responsive action.

B. Informational Submittals: Written information that does not require Designer's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Designer for Contractor's use in preparing submittals upon request after payment in full of fees for preparation and handling of the requested files/media and acceptance of the "Conditions of Use Agreement".

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. 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. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received. This particularly applies to finishes and major building systems.

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Designer's receipt of submittal. 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 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Designer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
      a. It shall be understood that all submittals containing information related to the Work of members of the design team employed as consultants will require sequential review and thus the longer review period.

E. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Designer.
   3. Include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name and address of Designer.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Submittal number or other unique identifier, per submittal, including revision identifier.
      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.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless Designer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Designer will return submittals, without review, received from sources other than Contractor.
   1. Transmittal Form: Use AIA Document G810 or Contractor's standard equivalent.
   2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Designer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. 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 "Approved or Approved as Noted."

J. 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.

K. Use for Construction: Use only final submittals with mark indicating "Approved or Approved as Noted" affixed and signed by Designer.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Files will not be graphically altered by Designer for intended purpose, or from existing format (typically AutoCad 2000).
   2. Fees established by various team members must be paid in full prior to issuance of files. The fees are $75/file. These charges are to cover preparation, formatting, handling and postage if applicable.
   3. Files will be transmitted either electronically by e-mail, or Compact Disk at requester's discretion without affecting fees.
   4. Recipient of files must confirm receipt and affirm conditions of use of files by signing and returning a "Conditions of Use Agreement", attached at the end of this Section.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. 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 printed 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 written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operation and maintenance manuals.
k. Compliance with specified referenced standards.
l. Testing by recognized testing agency.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit six (6) copies of Product Data, unless otherwise indicated. Designer will return three (3) copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittals of Designer's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Shopwork manufacturing instructions.
f. Templates and patterns.
g. Schedules.
h. Design calculations.
i. Compliance with specified standards.
j. Notation of coordination requirements.
k. Notation of dimensions established by field measurement.
l. Relationship to adjoining construction clearly indicated.
m. Seal and signature of professional engineer if specified.
n. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring, including power, signal, and control wiring.
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. Number of Copies: Submit six (6) opaque copies of each submittal. Designer will retain three (3) copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.

D. Samples: Submit Samples 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. 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 appropriate Specification Section.

3. 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.
4. 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 two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Designer will return submittal with options selected.

E. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

F. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

G. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

H. 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. 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.
4. Number of Copies: Submit six (6) copies of subcontractor list, unless otherwise indicated. Designer will return three (3) copies.
   a. Mark up and retain one returned copy as a Project Record Document.

I. Commissioning Submittals: Comply with requirements specified in Division 1 Section "General Commissioning Requirements and as otherwise specified in the Division 15 and 16 Sections."
1. Number of Copies: Submit three (3) copies of Commissioning submittals, unless otherwise indicated.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit three (3) copies of each submittal, unless otherwise indicated. Designer will not return copies.
2. Certificates and Certifications: Provide a notarized 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.

3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare 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.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare 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.

K. Product Test Reports: Prepare written reports indicating 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.

L. Research/Evaluation Reports: Prepare 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.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare 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.

O. Compatibility Test Reports: Prepare 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.

P. Field Test Reports: Prepare 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.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

R. Design Data: Prepare 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.

S. Manufacturer's Instructions: Prepare 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.

T. Manufacturer's Field Reports: Prepare 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.

U. Insurance Certificates and Bonds: Prepare 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.

V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Designer, except as required in "Action Submittals" Article.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. 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 Designer.

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, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

A. General: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Designer will review each submittal, make marks to indicate corrections or modifications required, and return it. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Final Unrestricted Release: Where submittals are marked "Approved," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
2. Final-But-Restricted Release: When submittals are marked "Approved as Noted," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
3. Returned for Resubmittal: When submittal is marked "Not Approved, Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
4. Rejected: Where submittals are marked "Rejected", it is nonconforming with the Contract Documents and is not appropriate for use in the Work.
5. Specific Action: When submittal is marked " Submit Specific Item ", resubmit that item specifically requested. Other components not marked may be proceeded with.
6. Do not permit submittals marked " Revise and Resubmit " or " Rejected " to be used at the project site, or elsewhere where Work is in progress.

C. Informational Submittals: Designer will review each submittal and will not return it, or will return it if it does not comply with requirements. Designer will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01330

SECTION 01400 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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, to be provided the Owner at the Contractor's expense, do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -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 -control procedures that facilitate compliance with the Contract Document requirements.
   3. Provisions of this Section do not limit requirements for Contractor to provide quality-assurance and -control services required by Designer, Owner, or authorities having jurisdiction, in addition to testing to be performed by Owner's Testing Lab(s).

C. Related Sections include the following:
   1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
   3. Divisions 2 through 16 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 Designer.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. 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 industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. 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. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

1.4 CONFLICTING REQUIREMENTS

A. General: 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 uncertainties and requirements that are different, but apparently equal, to Designer 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 Designer for a decision before proceeding.

1.5 SUBMITTALS

A. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Identification of applicable standards.
   3. Identification of test and inspection methods.
   4. Number of tests and inspections required.
   5. Requirements for obtaining samples.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. 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 record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. 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 to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications 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. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. 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 548; 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.

H. 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.

I. 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 Designer.
   2. Notify Designer seven days in advance of dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Designer's and Construction Manager's approval of mockups before starting work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 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 by Owner from testing and inspecting funds budgeted as part of the School Funding.
   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. All tests and inspections are Contractor's responsibility, 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.
   1. Contractor shall engage a qualified testing agency to perform these quality-control services.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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 Division 1 Section "Submittal Procedures."

D. 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.

E. Testing Agency Responsibilities: Agency will cooperate with Designer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections. Testing Agency will perform as follows:
   1. Notify Designer 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. Will not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Shall not perform any duties of Contractor.

F. Associated Services: Contractor shall 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.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Contractor shall coordinate sequence of activities to accommodate required quality-assurance and -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.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner may engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Designer 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 Designer 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. 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. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Designer'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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

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 01400

SECTION 01420 – REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 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 Designer's action on Contractor's submittals, applications, and requests, "approved" is limited to Designer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Designer. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "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."

E. "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.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "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.

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 standards in effect as of date of the Contract Documents, unless otherwise 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.

D. Abbreviations and Acronyms for 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, telephone numbers, 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.

ADAAG	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.access.gpo.gov/nara/cfr	(888) 293-6498 (202) 512-1530
CRD	Handbook for Concrete and Cement Available from Army Corps of Engineers Waterways Experiment Station www.wes.army.mil	(601) 634-2355
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point www.dodssp.daps.mil	(215) 697-6257
	Available from General Services Administration www.fss.gsa.gov	(202) 501-1021
	Available from National Institute of Building Sciences www.nibs.org	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point www.dodssp.daps.mil	(215) 697-6257

UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

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 indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

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, telephone numbers, 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.

BOCA	BOCA International, Inc. (See ICC)	
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	(703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

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, telephone numbers, 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.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-6816

DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOE	Department of Energy www.eren.doe.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PHS	Office of Public Health and Science www.phs.os.dhhs.gov	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

D. State of Maine Government Agencies and Local 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, telephone numbers, 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.

BGS	Bureau of General Services Division of Professional Services www.state.me.us/bgs	(207) 624-7360
DOE	Department of Education www.state.me.us/education/const/homepage.htm	(207) 624-6600
DEP	Department of Environmental Protection Southern Maine Regional Office (SMRO), Portland www.maine.gov/dep/index.html	(888) 769-1137
SFMO	Department of Public Safety Fire Marshall's Office www.state.me.us/dps/fmo/homepage.html	(207) 626-3880
DIF&W	Department of Inland Fish & Wildlife Bureau of Resource Management www.state.me.us/ifw/contactinformation.htm	(207) 287-8000
DOL	Department of Labor (Regulations and Safety) www.state.me.us/labor	(207) 624-6400
DOT	Department of Transportation Southern-Region 1 – Scarborough www.maine.gov/mdot/index.php	(207) 624-3000 (207) 885-7000

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 01500 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:
1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
2. Division 1 Section "Execution Requirements" for progress cleaning requirements.
3. Divisions 2 through 16 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Designer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to Designer, occupants of Project, testing agencies, and authorities having jurisdiction.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

A. 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.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its

use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement: Comply with Division 2 Section "Paving, Walks and Curbs."

B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry".

C. 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/C 36M.

D. 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.

E. Paint: Comply with requirements in Division 9 painting Sections.

F. Temporary Fencing: Provide 11 gauge galvanized 2 inch chain link fencing 5-feet high and galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts. Provide lockable gates for access.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Field Office to be Shared by Owner's Representative, Clerk-of-the-Works and Architect: Provide a portable or semi-permanent office facility that is secure, stable, of sufficient size to accommodate needs of personnel and located to be easily accessed, near temporary parking spaces. Furnish and equip offices as follows:
   1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases. Furnish room with conference table, chairs, and 4-foot- square tack board.
   2. Office shall contain a room of sufficient size to accommodate meetings of 10 individuals.
   3. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall.
   4. Provide phone connections with not less than 2 modular universal phone jacks, one each at desk and plan table locations.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by

locations and classes of fire exposures.

B. Temporary Heating Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use 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. 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 services as required for project.

B. Owner Occupied Building: It is mandatory that any disruption of any utility service at the Riverton facility be scheduled.
   1. All requests for utility service disruption must be given to the Architect 10 days in advance for review and approval. The Owner reserves the right to deny specific dates for disruption do to activities scheduled at the school.
   2. If at all possible reflect planned utility disruptions on construction schedule.

C. Water Service: Until permanent water supplies are operational, provide temporary water sources for construction needs including concreting, masonry work, dust control and potable water. Install temporary water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Units shall be serviced at regular intervals and be equipped to meet the needs of the workforce including women, as required.

E. Heating: Provide temporary heating 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: Provide temporary electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install temporary electric power service overhead, unless otherwise indicated.
2. Provide adequate capacity of circuit(s) and distribution equipment including Ground Fault protection to comply with Safety Regulations and Project requirements.

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.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
   a. Police and fire departments.
   b. Ambulance service.
   c. Contractor's home office.
   d. Architect's office.
   e. Engineers' offices.
   f. Owner's office.
   g. Owner's Representative office.
   h. Principal subcontractors' field and home offices.
2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities within the new school, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary parking areas for construction personnel.
1. Parking for construction personnel will be provided in the existing onsite lot. All vehicles are to be parked in lot unless specifically used at the construction site. Coordinate with Portland Public Schools requirements for designated spaces.
2. During school session it is mandatory that onsite vehicular traffic be kept to a minimum. Provide Riverton School Administration with 5 day notice of any significant traffic and deliveries occurring at the construction site.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations, maintain safety and access to Work.

E. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings and herein. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
   1. Provide temporary, directional signs for construction personnel and visitors.
   2. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Division 1 Section "Construction Waste Management."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes, Lulls and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Division 1 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 2 Sections "Site Clearing" and "Earthwork" and Erosion Control Drawings.
   1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees indicated to remain and those outside the Limit of Work zones indicated, to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Maintain Project conditions and progressively clean the Work Areas to minimize attraction and harboring of rodents, roaches, and other pests so Project will be free of pests and their residues at Substantial Completion. Perform any necessary control operations lawfully, using environmentally safe materials.

F. Security Enclosure and Lockup:
   1. The Designated Construction areas are to be completely fenced with temporary chain link fencing and gates as shown on site plans.

2. Provide lockable entrances at the access road(s) to the designated construction sites to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. 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 is needed and permanent enclosure is not complete, insulate temporary enclosures.

I. 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.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -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.

3.5 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.
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 unless approved in writing by Owner, Designer and State.

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, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 01500

SECTION 01524 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Salvaging recycling, and disposing of nonhazardous construction waste.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
   2. Division 2 Section "Site Clearing" for disposition of waste resulting from site clearing and grubbing.
   3. Division 4 Section "Unit Masonry Assemblies" for disposal requirements for masonry waste.

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. 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.

C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. Salvage/Recycle Goals: Owner's goal is for Construction Team to salvage and recycle as much nonhazardous construction waste as possible.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect and Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with Division 1 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. 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.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
   1. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

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.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01524

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. General installation of products.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting systems.
   7. Protection of installed construction.
   8. Correction of the Work.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 1 Section "Submittal Procedures" for submitting surveys.
   3. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
   4. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing construction layout land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.
   2. Contact Dig-Safe and On-Target Utilities location services to identified buried systems prior to start of work, in compliance with local regulations.

3. Before construction, verify the location and invert elevation at points of connection to water-service piping.
4. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Acceptance of Conditions: 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. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. 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 local utility and Owner's Representative 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. 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.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Designer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Designer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere 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 Designer when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, 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.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Designer.

3.4 FIELD ENGINEERING

A. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 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 clearance of 7 feet in spaces without a suspended ceiling.

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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. 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.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Designer or as required for compliance with the Americans with Disabilities Act (ADA) and UFAS.
   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.

H. 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.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   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.

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 materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

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 operating components for proper operation without binding. Adjust equipment for proper operation.

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 Division 1 Section "Quality Requirements."

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 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:
   1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
   2. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.

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 surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time significant cutting and patching will be performed, requesting approval to proceed. Include the following information:
   1. Definition: Significant cutting and patching includes; Fire-rated construction of any type, structural components or load-bearing walls, completed or assembled systems requiring assistance of respective trades to complete cut and patch, etc.
   2. Extent: Describe cutting and patching, show how it is to be performed, and indicate why it cannot be avoided.
   3. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   4. Products: List products to be used and firms or entities that will perform the Work.
   5. Dates: Indicate when cutting and patching will be performed.
   6. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
   7. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

8. Approval: Obtain Designer's approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
   1. Structural elements and that require Designer's approval of a cutting and patching proposal;
      a. Structural Steel
      b. Load bearing concrete masonry units.
      c. Metal Decking

B. 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. Operating elements include the following:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Fire-suppression systems.
   4. Mechanical systems piping and ducts.
   5. Control systems.
   6. Communication systems.
   7. Conveying systems.
   8. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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. Miscellaneous elements include the following:
   1. Water, moisture, or vapor barriers.
   2. Membranes and flashings.
   3. Exterior curtain-wall construction.
   4. Equipment supports.
   5. Piping, ductwork, vessels, and equipment.
   6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Designer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Building Operations: The building is 100% occupied during construction, 7 days a week. Do not cut or patch any materials or systems that will result in any system within the building shutting down or resulting in any utility service interruptions.

F. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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 in-place finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. 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.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. 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 minimize interruption to occupied areas.

3.3 PERFORMANCE

A. 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. 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 as small as possible, neatly to 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.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 2 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.

C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate 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, apply primer and intermediate paint coats 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. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01731

SECTION 01770 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for phasing closeout and contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Division 1 Section "Summary of Work" for Phasing requirements.
   2. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   3. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
   4. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 SUBSTANTIAL COMPLETION OF A PHASE

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion of a specific phase, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from that part of the Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements. Designer 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 Designer, 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.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection of a phase for determining date of Final Completion, complete the following:
   1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
   2. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Designer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes or other recording media.

B. Inspection: Submit a written request for final inspection for acceptance of the completed phase. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements. Designer 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.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit six (6) copies of list. Include name and identification of each space and area affected in the Phase 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 Designer.
   d. Name of Contractor.
   e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Designer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-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.

D. 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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide 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 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. 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.
   f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   g. Sweep concrete floors broom clean in unoccupied spaces.
   h. Mop, seal and wax VCT resilient flooring as required by manufacturer and as specified in contract specifications using materials compatible with Owner's standard maintenance system(s).
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo 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. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
   m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   n. Replace parts subjected to unusual operating conditions during construction.
   o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   q. Clean ducts, blowers, and coils of all visible dust or debris; particularly if units were operated without filters during construction.
   r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   s. Leave Project clean and ready for occupancy with all debris and waste removed from all spaces.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 01781 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Product Data.

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up Record Prints.

B. Record Product Data: Submit one copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit two copies of marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   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 prepare the 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 understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
   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 Designer'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 or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
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 Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Designer 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 Designer 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 Designer.
e. Name of Contractor.

2.2 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 and Record Drawings where applicable.

2.3 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.

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. Maintain two copies of each submittal during the construction period for items to be included in Owner's Project Operation and Maintenance Manual (O & M). Post changes and modifications to Project Record Documents as they occur; do not wait until the 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 Designer's reference during normal working hours.

END OF SECTION 01781

SECTION 01810 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:
1. Division 1 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.

1.3 DEFINITIONS

A. BoD: Basis of Design.

B. CxA: Commissioning Authority.

C. OPR: Owner's Project Requirements.

D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

E. TAB: Testing, Adjusting, and Balancing.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of the Contractor, including Project superintendent may include subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

C. Provide utility services required for the commissioning process.

D. Provide the BoD documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities .

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.

C. Prepare commissioning reports.

D. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process.

B. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

C. Test and Inspection Reports: CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

D. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.
   1. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment

have been completed and are performing according to the OPR, BoD, and Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:
1. Verify that Electrical and HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Verify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.
3. Verify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

3.2 TAB VERIFICATION

A. TAB Contractor shall coordinate with CxA for work required in Division 15 Section "Testing, Adjusting, and Balancing." TAB Contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. CxA may witness the TAB Work.

C. TAB Preparation:
1. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 15 Section "Testing, Adjusting, and Balancing."
   a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork Air Leakage Testing (where applicable):
1. Designer will identify, for HVAC Contractor and CxA, portions of duct systems to have ductwork air leakage testing. Ductwork air leakage testing shall be performed according to Division 15 Section "Metal Ducts," and shall be witnessed by the CxA.
2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.

E. CxA shall verify that TAB Work has been successfully completed.

3.3 TESTING

A. Testing shall be performed by the contractor, under the supervision of the CxA.

B. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

C. Perform tests using design conditions whenever possible.
   1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
   2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
   3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

D. Scope of HVAC Contractor Testing:
   1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
   2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

E. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Contractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

3.4 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training shall be performed by the contractor, under the supervision of the CxA.

END OF SECTION 01810

SECTION 01820 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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.
   3. Demonstration and training videotapes.

B. Related Sections include the following:
   1. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including 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. At completion of training, submit one complete training manual for Owner's use.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Demonstration and Training Videotapes: Submit one (1) copy within ten days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of photographer.
      c. Name of Designer.
      d. Name of Contractor.
      e. Date videotape was recorded.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Photographer/Videographer Qualifications: A professional photographer or cameraman who is experienced in photographing construction projects.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

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 Designer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
1. Fire-protection systems, including fire alarm and fire-extinguishing systems.
2. Intrusion detection systems.
3. Heat generation, including boilers, feedwater equipment, pumps and water distribution piping.
4. Refrigeration systems, including condensers, pumps and distribution piping.
5. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
6. HVAC instrumentation and controls.
7. Electrical service and distribution, including transformers, switchboards, panelboards, motor controls and transfer switches.
8. Lighting equipment and controls including theater lighting and dimming systems.
9. Communication systems, including intercommunication, surveillance, clocks and programming, voice and data, and television equipment.

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:
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 combined training manual.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Designer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

B. 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, through Designer, with at least 10 days' advance notice.

C. 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.

3.3 DEMONSTRATION AND TRAINING VIDEOTAPES

A. General: Engage a qualified commercial photographer to record demonstration and training videotapes. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Videotape Format: Provide high-quality VHS color videotape in full-size cassettes.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on videotape by audio narration by microphone while videotape is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION 01820

SECTION 02070 - SELECTIVE DEMOLITION

PART 1. - GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section requires the selective removal and subsequent off site disposal of the following:
   a. Portions of existing building indicated on Drawings and as required to accommodate new construction, including masonry partitions, hollow metal framing, ceiling systems, and fixtures.

C. JOB CONDITIONS

1. Occupancy: Owner will occupy portions of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will affect Owner's normal operations.
2. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
   a. Storage or sale of removed items on site will not be permitted.
3. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
   a. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to occupied portions of building.
   b. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
   c. Protect floors with suitable coverings when necessary.
   d. Construct temporary insulated dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
   e. Remove protections at completion of work.
4. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
5. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of ducts and pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.
6. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

a. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
b. Maintain fire protection services during selective demolition operations.
c. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

D. REMOVAL OF HAZARDOUS MATERIALS

1. If during the course of work the existence of asbestos or other hazards and regulated materials is encountered in the structure or building, other than those areas indicated, promptly notify the Architect. The Owner will consult with his Hazardous Material Consultant regarding the removal or encapsulation of the material. Do not perform any work pertinent to the discovered material prior to receipt of written special instructions from the Owner.

PART 2. - PRODUCTS (Not Applicable)

PART 3. - EXECUTION

A. PREPARATION

1. Cease operations and notify Owner immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
2. Cover and protect furniture, equipment, and fixtures from soilage or damage when demolition work is performed in areas where such items have not been removed.
3. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.
4. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 1/2" fire - retardant plywood on occupied side, 6 mil poly vapor barrier on demolition side.
5. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.
6. Provide bypass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shutdown of service is necessary during changeover.

B. DEMOLITION

1. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
2. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.

3. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
4. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
5. If unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Engineer in written, accurate detail. Pending receipt of directive from Engineer, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

C. DISPOSAL OF DEMOLISHED MATERIALS

1. Remove from building site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose off site.
2. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.
3. Burning of removed materials is not permitted on project site.

D. CLEANUP AND REPAIR

1. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean.
2. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION 02070

SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

Provide all labor, tools, equipment and materials necessary to protect designated structures, trees and other vegetation within clearing limits and clear the area indicated on the drawings and as necessary to complete the work.

1. Protecting trees and vegetation beyond the clearing limit as necessary.
2. Remaining trees and other vegetation within the clearing limits.
3. Grubbing.
4. Stripping and stockpiling topsoil.

A. Coordinating this work with surveyor and protect property monuments and ground control for new work.

B. Coordinating site clearing with installation of temporary erosion control measures.

C. Coordinating with Owner prior to conducting site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

D. Restoring damaged improvements to their original condition, as acceptable to property owners.

1.2 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02210 – Temporary Erosion Control

1.3 PROJECT CONDITIONS:

A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Comply with contractor site utilization areas for access to work areas.

B. Protection of Existing Improvements: Protect improvements on adjoining properties and on Owner's property.

C. Restore damaged improvements to their original condition, as acceptable to property owners.

D. Install appropriate soil erosion measures prior to commencement of work.

1.4 QUALITY ASSURANCE:

A. General: Comply with requirements of Section 01340 - Quality Assurance; Submittals.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING TREES AND VEGETATION:

A. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

B. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

C. Provide protection for roots over 1-1/2 inches in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

D. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to Owner. Employ a licensed arborist to repair damages to trees and shrubs.

3.2 SITE CLEARING:

A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. "Removal" includes digging out and off-site disposal of stumps and roots. Stumps and roots may be ground and used on site as erosion control berms.

B. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

C. Use only hand methods for grubbing inside drip lines of trees indicated to be saved or protected.

3.3 TOPSOIL STRIPPING:

A. Topsoil is defined as friable loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, other objects over 2 inches in diameter, weeds, roots, and other objectionable material.

B. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.

C. Leave topsoil in place within drip lines of trees specified to remain to prevent damage to root system.

D. Stockpile topsoil in storage piles in areas indicated or specified as stockpile areas. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion, or seed with temporary seed mix.

3.4 DISPOSAL OF WASTE MATERIALS:

A. Remove and legally dispose of all unsuitable material, waste materials, and spoil from the site.

B. Burning will not be permitted.

END OF SECTION 02110

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Work Includes: All excavating, filling, backfilling, removal of materials, shoring and bracing, and dewatering.

Earthwork for utilities is included in this section.

1.2 PROTECTION:

A. Paved Surfaces: Do not operate equipment on paved surfaces which will damage these surfaces. If damaged, the repair will be at the cost of the contractor.

B. Maintain excavations with approved barricades, lights, and signs to protect life and property until excavation is filled and graded to a condition acceptable to the Architect.

C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1.3 QUALITY ASSURANCE:

A. Testing and Inspection Service by Owner: Owner will engage soil testing and inspection service for quality control testing during earthwork operations. See Section 01400 for general requirements. Contractor will pay for all aggregate gradation testing. Owner will pay for moisture maximum density tests and field compaction tests as stated in Section 01400.

1.4 SUBMITTALS:

A. Test Reports: Submit the following reports:

- Reports on Material Gradations
- One optimum moisture-maximum density curve for each type of soil encountered

1.5 JOB CONDITIONS:

A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. Existing Utilities: Locate existing utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Owner immediately for directions. Cooperate with Owner in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.

Keep existing sewers and sewer services in operation for the duration of the work. Maintain and operate new and existing sewers until the entire sewer system is complete and operating.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with Owner for shutoff of services if lines are active.

C. Use of Explosives: Not permitted unless required by change order for rock excavation.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General:

1. Suitable Materials: Materials shown on the Drawings, or specified herein.

2. Unsuitable Materials: Materials containing clay, vegetation, organic matter, debris, pavement, stones, or boulders over 6 inches in greatest dimension, and frozen material. Any material which, in the opinion of the Architect, will not provide a suitable foundation or subgrade.

3. On-Site Materials: Any suitable material from on-site excavation must meet the gradation for its intended use.

4. Material for embankments and general fills may contain pieces of excavated ledge having a greatest dimension of up to 12 inches if approved by the Architect.

5. Inspection: The Architect may inspect off-site sources of materials and order tests of these materials to verify compliance with these specifications.

B. Gravel: Hard, durable stone with coarse to fine sand. Sieve analysis by weight:

Sieve Size	% Passing
3"	100
1/4"	30 - 70
40	0 - 30
200	0 - 5

C. Sand: Sieve analysis by weight:

Sieve Size	% Passing
3/8"	100
No. 4	95 - 100
No. 16	50 - 85
No. 100	2 - 10

D. 3/4" Crushed Stone: Durable, clean angular rock fragments obtained by breaking and crushing rock material. Sieve analysis by weight:

Sieve Size	% Passing
1"	100
3/4"	95-100
1/2"	35-70
3/8"	0-25

E. Aggregate Base: Hard, durable crushed gravel, containing only particles passing the 2" sieve. Sieve analysis by weight:

Sieve Size	% Passing
1/2"	45-70
1/4"	30-55
No. 40	0-20
No. 200	0-5

F. Aggregate Subbase and Gravel: Hard durable gravel containing only particles passing the 6" sieve. Sieve analysis for portion passing 3 inch sieve:

Sieve Size	% Passing
1/4"	25-70
No. 40	0-30
No. 200	0-7.0

G. Refill Material: Crushed stone for refilling excavation below grade or rock excavation unless otherwise directed by the Architect.

H. Granular Fill: Sand or gravel of hard, durable particles, free from clay, organic material, vegetation, and debris.

Unsuitable Material for Granular Fill: Pieces of concrete, masonry, and pavement; stones having a dimension of 6 inches or more; material that cannot be properly compacted.

Obtain approval from the Architect before using any material as granular fill.

I. Select Backfill: Use gravel as specified above.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. General: Remove all materials encountered to the limits shown on the drawings, or designated in the specifications.

Do not perform excavation for structure, rock excavation, or excavation below grade until material to be excavated has been cross-sectioned and classified by Engineered.

B. Classifications: Excavation will be classified as earth excavation or rock excavation when unanticipated rock excavation is encountered in work.

Do not perform rock excavation until material to be excavated has been cross-sectioned and classified by Architect. Rock excavation will be paid on basis of contract conditions relative to changes in work.

C. Earth Excavation: Removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

D. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus of minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

E. Rock Excavation: Removal and disposal of materials that cannot be excavated without drilling and blasting, or the use of special equipment, except such materials that are classified as earth excavation.

Typical materials classified as rock are solid rock, rock in ledges, and rockhard cementitious aggregate deposits one cubic yard or more in volume.

Intermittent drilling or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

F. Rock Excavation Does Not Include:

Removal of material which can be removed with a hand pick or power shovel.
Loose or previously blasted rock or broken stone in rock fills or elsewhere.

Over excavate rock encountered near the bottom of excavations as directed by Architect if partial bearing of foundation on rock may result. Refill material, if required, will be paid for as Select Backfill.

G. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations, and grades as shown.

H. Excavation in Paved Areas: Cut pavement prior to excavation to provide a clean, uniform edge. Minimize disturbance of remaining pavement. Cut and remove the minimum amount of pavement required to do the work.

Use shoring and bracing where sides of excavation will not stand without undermining pavement.

I. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room.

Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of bedding material prior to installation of pipe.

Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

J. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, including refilling, is at Contractor's expense.

K. Refilling Unauthorized Excavation:

1. Trenches: Use crushed stone or gravel.

2. Earth Excavation for Structures: Use gravel.

3. Elsewhere: Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect.

4. Rock excavation for structures: Use concrete having 28-day compressive strength of 2000 psi or granular material as directed by the Architect.

L. Excavation Below Grade: When excavation has reached required subgrade elevations, notify Architect who will make an inspection of conditions. If unsuitable materials exist at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Architect.

Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

M. Material Storage: Stockpile suitable excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations.

3.2 STABILITY OF EXCAVATIONS:

A. General: Slope sides of excavations to comply with OSHA regulations and local codes. Shore and brace where sloping is not possible.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

B. Shoring and Bracing: Provide materials for shoring and bracing to comply with OSHA requirements and local codes.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

3.3 DEWATERING:

A. General: Perform all work in the dry. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Provide and maintain pumps and dewatering system components necessary to convey water away from excavations.

Convey water removed from excavations and rain water to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

B. Payment: Costs of dewatering are incidental to other work. No payment will be made for dewatering, including dewatering required for excavation below normal grade.

3.4 BACKFILL AND FILL:

A. General: Place acceptable soil material in layers to required elevations as shown on the Drawings and as listed below.

Fill, backfill, and compact to produce minimum subsequent settlement of the material and provide adequate support for the surface treatment or structure to be placed on the material. Place material in approximately horizontal layers beginning at lowest area to be filled. Do not impair natural drainage.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptance of construction below finish grade, including dampening, waterproofing, and perimeter insulation.

Inspection, testing, approval, and recording locations of underground utilities and pipe.

Removal of concrete formwork.

Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

Removal of trash and debris.

Permanent or temporary horizontal bracing is in place on horizontally supported walls.

Use care in backfilling to avoid damage or displacement of underground structures and pipe.

C. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of materials. Plow, strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

D. Placement: Place backfill and fill materials in layers not more than 12" in loose depth for material compacted by heavy compaction equipment and not more than 6" in loose depth for material compacted by hand operated tampers. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

Backfill cast-in-place concrete structures when the concrete has developed adequate strength. Do not allow heavy machinery within 5 feet of structure during backfilling and compacting.

E. Pipe Bedding: Bed pipe in stone.

F Replacement of Unsuitable Materials:

1. Below Normal Grade: See Paragraph 3.01

2. Above Normal Grade: Replace unsuitable material with suitable on-site material or common borrow. If additional material is required, use Select Backfill. Payment for Select Backfill will be made on the basis of contract conditions relative to change in the work.

3.5 COMPACTION:

A. Methods: Use methods which produce the required degree of compaction throughout the entire depth of material placed without damage to new or existing facilities and which are approved by the Architect. Adjust moisture content of soil as required. Remove and replace material which is too wet to compact to required density.

B. Degree of Compaction: Compact to the following minimum densities:

Fill & Backfill Location	Density
Under Structure Foundations	95% of max.
Top 2 Feet Under Pavement	95%
Below Top 2 Feet Under Pavement	93%
Trenches Through Unpaved Areas	90%
Embankments	90%
Pipe Bedding	90%
Within 10 Feet of Structure Foundation Walls, Tank Walls, & Retaining Walls	91-93%
Subfloor Fill Not Supporting Footings	92%

Maximum Density: ASTM D1557, modified

Field Density Tests: ASTM D1556 (sand cone), ASTM D2167 (rubber balloon), or ASTM D2922 (nuclear)

C. Testing: Determine actual in-place densities using field tests as directed by the Architect. Tests will be made by an independent laboratory. Costs for initial tests will be paid by Owner; see Section 01400.

Perform additional work to obtain proper compaction if in-place densities do not meet the specified densities. Retesting may be required by the Architect.

D. Minimum Number of Tests:

1. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be related tested strata, when acceptable to Architect.

2. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 square feet of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 square feet of overlaying building slab or paved area, but in no case less than 3 tests.

2. Foundation Wall Backfill Outside of Structure: Make at least two field density tests at locations and elevations as directed.

3.6 GRADING:

A. Grading: Uniformly grade areas within limits of grading, including adjacent transition areas. Smooth finished surface within specified tolerances and compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

DELETE BELOW IF NONE

B. Grading Outside Building Lines: Grade areas adjacent to structure line to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes as follows:

1. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

2. Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.

3. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

4. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10' above or below required subgrade elevation.

D. Compaction: After grading, compact subgrade surfaces to the percentage of maximum density for each area classification.

E. Pavement Base: Place on prepared subgrade in layers of uniform thickness conforming to indicated cross-section and thickness.

3.7 PAVEMENT SUBBASE COURSE:

A. General: Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course.

B. Grade Control: During construction, maintain lines and grades, including crown and cross-slope of subbase course.

C. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

When a compacted subbase course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.8 BUILDING SLAB DRAINAGE COURSE:

A. General: Drainage course consists of placement of drainage fill material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.

B. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3. 9 MAINTENANCE:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Owner's property.

B. Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Architect.

3.11 GEOTEXTILES:

A. Install as shown on the Drawings in accordance with manufacturer's recommendations.

END OF SECTION 02200

SECTION 02210 - TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide and maintain erosion control devices to control erosion that occurs during construction operations, prior to completion of permanent erosion control devices.

B. Related Work Specified Elsewhere: All Sections of Division 2, Sitework.

1.2 QUALITY ASSURANCE:

A. Prior to the start of construction, meet with the Engineer to discuss erosion control requirements.

B. Payment of fines issued to Owner as a result of poor erosion control by the Contractor.

1.3 SUBMITTALS:

A. Prepare an Erosion Control Program and submit to Engineer for approval prior to construction startup.

PART 2 - MATERIALS

2.1 Use the following materials in construction of erosion control devices. Other materials require approval of the Engineer.

A. Baled Hay: Securely tied and staked twice per bale.

B. Sand Bags: Heavy cloth bags of approximately 1 cubic foot capacity filled with sand or gravel.

C. Mulches:

1. Asphalt emulsion, loose hay, straw, pine straw or needles, sawdust, wood chips, wood excelsior, or wood fiber cellulose.

2. Type and use as specified in the Maine Erosion and Sediment Control Handbook For Construction: Best Management Practices prepared by the Cumberland County Soil and Water Conservation District and the DEP, March 1991, hereinafter referred to as the BMP's.

D. Mats and Nettings:

1. Twisted craft paper, yarn, juts, excelsior, wood fiber mats, glass fiber, and plastic film.

2. Type and use shall be as specified by the Environmental Quality Handbook.

E. Seed:

1. Standard conservation mix of 100% annual rye grass or field bromegrass.

2. Equivalent seed mixture as approved by the Engineer.

F. Sod:

1. Grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases, and other pest problems.

2. At least one year old and not older than three years. Cut with a 1/2-inch to 1-inch layer of soil.

G. Drains:

1. Flexible drains consisting of collapsible neoprene pipe, minimum 8-inch diameter, or an approved equal.

2. Corrugated metal pipe and inlet or a gauge consistent with the loading conditions, minimum 12-inch diameter or approved equal.

H. Siltation Fence: Mirafi Environfence or approved equal.

PART 3 - EXECUTION

3.1 TEMPORARY DEVICES: Use the following devices to control erosion. Other devices require approval of the Engineer.

A. Temporary Erosion Checks: Construct temporary erosion checks at 100-foot minimum intervals in ditches or where designated by the Engineer using baled hay and temporary siltation fence.

B. Temporary Berms: Construct temporary barriers along the toe of embankments using side drains as required.

C. Temporary Slope Drains: Drains shall be collapsible pipe with corrugated metal pipe inlet.

D. Sedimentation Basins: Barriers and berms shall be used to construct sedimentation basins to prevent off-site transport of silt with site runoff. Basins shall be sized to limit pass-through flow velocities to 0.01 feet per minute.

3.2 APPLICATION RATES:

A. Seed for Temporary Cover: 40 pounds per acre

B. Loose Hay or Straw: 2 tons per acre

3.3 REMOVAL OF TEMPORARY EROSION CONTROL:

A. Temporary materials and devices shall be removed when permanent soil stabilization has been achieved. Materials in good condition may be reused on the site if approved by the Engineer. Materials unsuitable for reuse shall become the property of the Contractor and shall be disposed of in a manner and location approved by the Engineer.

END OF SECTION 02210

SECTION 02513 - HOT BITUMINOUS PAVEMENT

PART 1 - GENERAL

1. 1 DESCRIPTION OF WORK:

A. General: Provide hot bituminous pavement as shown on the Drawings. This work includes temporary and permanent trench paving and pavement overlay.

1.2 QUALITY ASSURANCE:

A. Standards: "Standard Specifications Highways and Bridges," revision of January 1984, Maine Department of Transportation.

B. Pavement Supplier and Plant: MDOT "Standard Specification," Section 401.08.

1.3 SUBMITTALS:

A. Material Certificates: Certificates signed by material producer and Contractor stating that each material complies with specified requirements.

B. Design Mix: Provide for each truckload of hot bituminous material.

C. Certified Weigh Slips: Provide for each truckload of hot bituminous material.

1.4 JOB CONDITIONS:

A. Weather and Seasonal Limitations: MDOT "Standard Specification," Section 401.07.

B. Additional Limitations:

1. Apply bituminous prime and tack coats only when the ambient temperature in the shade is at least 50 degrees F for 12 hours immediately prior to application.

2. Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE:

A. General: See Section 02200 - Earthwork.

2.2 HOT BITUMINOUS PAVEMENTS:

A. General: Comply with materials requirements, MDOT "Standard Specification," Sections 403.

B. Base Course: 19 MM

C. Surface Course: 12 MM

2.3 BITUMINOUS TACK COAT:

A. General: MDOT "Standard Specifications," Section 702.04.

B. Grade: AE-90

PART 3 - EXECUTION

3.1 AGGREGATE BASE AND SUBBASE:

A. General: MDOT "Standard Specifications," Section 304.

3.2 HOT BITUMINOUS PAVEMENTS:

A. General: MDOT "Standard Specifications," Sections listed below.

B. Base Course: Section 301

C. Surface Course: Section 403

3.3 BITUMINOUS TACK COAT:

A. General: Apply tack coat immediately prior to placing pavement to edge of cut pavement for adequate bond. Generally, a tack coat will not be required for pavement placed immediately following the rolling of the underlying course.

B. Rate Application: 0.05 to 0.15 gallons per square yard.

3.4 TRENCH PATCHING:

A. General: Place aggregate subbase and base as shown on the drawings and as specified in Section 02200.

B. Permanent Patching:

1. Remove temporary pavement. Mechanically cut edges of existing pavement to a neat square edge to prevent deterioration of remaining pavement. Regrade base material and compact as required.

2. Provide base and surface courses to the depths shown on the drawings.

3.5 WINTER CONSTRUCTION MAINTENANCE:

A. General: If hot bituminous pavement is not available, provide cold patch and maintain trench until paving can be completed.

END OF SECTION 02513

SECTION 02550 - SEWERS AND DRAINS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide sanitary sewer and storm drain system as shown on the drawings. This section includes sanitary sewer pipe and house service pipes.

Sanitary sewer pipe
Storm drain pipes
Underdrains

B. Earthwork: Section 02200 (includes excavation, bedding, backfill).

C. Manholes and Catchbasins: Section 02570.

D. Concrete: Section 03010.

1.2 QUALITY ASSURANCE:

A. Remove damaged pipe from job site.

1.3 SUBMITTALS:

A. Manufacturer's product data and installation instructions.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

A. General: Furnish fittings of same type and class of materials as pipe.

B. PVC Non-Pressure Pipe: ASTMD3034 or ASTMD3033, strength requirement SDR 35, push-on joints ASTMD3212, gaskets ASTMF-477.

C. Underdrain: Polyethelene perforated pipe, AASHTO M190.

2.2 MISCELLANEOUS:

A. Flexible Adaptors: Neoprene sleeve with stainless steel bands equal to those manufactured by Fernco, Calder Couplings.

B. Manhole Seals: Segmented neoprene seal with stainless steel bolts equal to "Link-Seal" as manufactured by Thunderline Corp.

C. Insulation: Equal to Styrofoam SM by Dow Chemical Co., sheet size 2' by 4' by 2" thick.

PART 3 - EXECUTION

3. 1 INSTALLATION OF GRAVITY PIPE AND FITTINGS:

A. Methods: Install in accordance with manufacturer's recommendations using a laser beam for line and grade. Secure each length of pipe with bedding before placing next length. Plug open ends when work is suspended. Bed pipe as shown on drawings.

B. Grade and Line: Lay pipe to line and grade shown on the drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points.

C. Conditions: Lay pipe in the dry. Do not use installed pipe to remove water from work area.

D. Cleaning: Flush all pipe and remove debris.

E. Connections to Manholes: Provide short length of pipe so that joints are located within 3 feet of inside surface of manholes.

3.2 INSULATION:

A. Install as shown on Drawings.

3.3 CONNECTION TO EXISTING STRUCTURES:

A. Where connections to existing manholes and catchbasins are required, core the existing structure and seal with Manhole Seals or Flexible Adaptors.

3.4 TESTING:

A. General: Test all pipes after backfilling. Install all house service leads on main line before testing. Perform tests in presence of Engineer or authorized representative of the Sewer District or Public Works Department.

B. Gravity Sewer-Leakage Tests: Use low-pressure air test as follows:

1. Plug ends of section to be tested.

2. Supply air slowly to the pipe to be tested until the air pressure inside the pipe is 4.0 psi greater than the average back-pressure of any groundwater submerging the pipe.

3. Disconnect air supply and allow a minimum of two minutes for stabilization of pressure.

4. Following stabilization period, measure drop in pressure over a 6-minute test period.

5. Acceptable Drop: No more than 1.0 psi.

C. Repair and retest: Repair all pipes not passing tests using materials and methods approved by the Engineer, and retest.

END OF SECTION 02550

SECTION 02570 – MANHOLES AND CATCHBASINS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide manholes as shown on the drawings. This section includes:

- Precast Manholes
- Masonry Inverts
- Frames and Covers
- Precast Catchbasin and Concrete Masonry Catch Basins

B. Earthwork: Section 02200

C. Sewers and Drains: Section 02550

D. Concrete: Section 03010

E. Pump Station: Section 11072

1.2 QUALITY ASSURANCE:

A. General: Provide complete manhole and catchbasin structures capable of supporting AASHTO H2O loading.

B. Precast Manhole and Catchbasin Components: ASTM C478

1.3 SUBMITTALS:

A. Shop Drawings: Submit for precast manholes. Show components to be used, elevations of top, base and pipe inverts, location of pipe penetrations, steps, etc.

B. Product Data: Manufacturers' product data and installation instructions for frames, grates, precast items, manhole sleeves, and joint sealants for precast sections.

PART 2 - PRODUCTS

2.1 MANHOLES:

A. Base Sections: Precast monolithic construction to a joint 16" minimum above crown of highest incoming pipe, with steps.

B. Barrel Sections: Precast with steps.

C. Top Sections: Precast eccentric cone with steps. Use flat cover only if shown on drawings.

D. Steps: Aluminum alloy 6061-T6 or polypropylene reinforced with steel rod. Meet OSHA requirements, minimum width 16". Coat aluminum to be cast into concrete with bituminous paint.

E. Pipe to Manhole Connections: Pipe sizes 8" or larger: Flexible manhole sleeves equal to CP series manufactured by Interpace Corp. size to fit diameter and type of pipe without use of gaskets.

F. Pipe to Catchbasin Connections: For pipe sizes 6" or larger, use flexible manhole sleeves equal to CP series manufactured by Interpace Corp., sized to fit diameter and type of pipe without use of gaskets.

8" PVC pipe, use CP-6
12" PVC pipe, use CP-10

Pipe sized less than 8": schedule 40 galvanized steel pipe sleeve with sequented rubber seal equal to "Link-Seal" by Thunderline Corp.

G. Joints Between Precast Sections: Watertight, shiplap type; seal with two rings of 1" diameter butyl rubber sealant.

H. Dampproofing: Bituminous coating on exterior of precast sections and parged brick.

2.2 CATCH BASINS:

A. Base Sections: Precast

B. Barrel Sections: Precast or combination of precast and concrete masonry units barrel block.

C. Top Sections: Precast eccentric cone or flat cover if required by grade.

D. Joints between precast sections: Shiplap type sealed with one ring of 1" diameter or square butyl rubber sealant.

E. Dampproofing: Bituminous coating on exterior of precast barrel block sections.

2.3 MASONRY MATERIALS:

A. Sewer Brick: ASTM C32, Grade SS, hard brick.

B. Concrete Masonry Units: ASTM C139.

C. Mortar: Type M, ASTM C270. Use Type II Portland cement, Type S lime.

1 part Portland cement, ¼ part hydrated lime. 3 to 3 ¾ parts sand.

2.4 FRAMES, GRATES, AND COVERS:

A. General:

1. Coatings for All Frames, Grates, and Covers: Two coats coal tar pitch varnish applied after sandblasting to provide a smooth, tough, non-brittle, non-scaling finish. Repair damage to coatings to the satisfaction of the Engineer.

2. Cast Iron: ASTM A48 Class 30.

B. Manhole Frames and Covers:

1. General: Minimum 22" dia. opening, minimum weight 350 pounds, labeled with "SEWER" in 3" high raised letters on cover.

2. Standard Frames and Covers: Equal to:

LC258-2 frame and L25C5 cover by E.L. Lebaron Foundry, Model R1760 frame and Type C cover with self-sealing application by Neenah Foundry, or
Equivalent

4. Catchbasin Frames and Grates: Equal to:

Model R2504-D frame and type C grate by Neenah Foundry, Model M72 x 7G by Etheridge Foundry.

2.5 MISCELLANEOUS:

A. Dampproofing: Provide bituminous coating equal to Dehydrate No. 4 Dampproof by W.R. Grace or Bitumastic Super Service Black by Koppers Co. for field application.

PART 3 - EXECUTION

3.1 INSTALLATION OF MANHOLES:

A. Placement: Place bases on compacted bedding material so catchbasin structure is plumb and pipe inverts are at proper elevations. Place barrel and top sections in the appropriate height combinations. Plug all lifting holes inside and out with non-shrink mortar.

B. Joints: Follow manufacturer's instructions for sealing joints between precast sections. Point joints with non-shrinking mortar.

C. Frames and Covers: Set to final grade as shown on the drawings or set flush with pavement grade in paved areas. Provide adequate temporary covers to prevent accidental entry until final placement of frame and grate is made.

D. Inverts: Construct smooth channels using sewer brick with semi-circular bottoms that match inside surface of pipes to be connected. Where changes in direction of
flow are made, fit pipes flush to inside surfaces of manholes and form channel with as large a radius as possible.

Slope bench 1/8 inch per foot from channel up to manhole wall.

E. Dampproofing: Repair damage to dampproofing and apply dampproofing to masonry as shown on drawings.

3.2 INSTALLATION OF CATCHBASINS:

A. Placement: Place bases on compacted bedding material so that structure is plumb and pipe inverts are at proper elevations.

B. Plug: lifting holes inside and out, fill spaces between pipes and catch basin walls with mortar and/or masonry and trowel smooth.

C. Concrete Masonry Construction: Construct walls in horizontal courses with vertical joints broken. Lay units in mortar, fill all joints completely with mortar. Parge inside and out with ½" parge coat of mortar.

D. Frames and Grates: Set to grade as shown on the Drawings.

E. Dampproofing: Repair damage to dampproofing and apply dampproofing to masonry as shown on the drawings.

3.3 MANHOLE TESTING:

A. General: Use vacuum test or exfiltration test for all sanitary sewer manholes. Perform tests before constructing invert or backfilling. No allowance will be made for absorption during the 8-hour exfiltration test period. No allowance will be made for leakage at test plugs.

B. Retests: Retest unacceptable manholes following repairs until acceptable leakage rate is attained.

C. Vacuum Test:

1. Plug pipes into and out of MH and seal MH opening.

2. Draw a vacuum of 10 inches of Hg and hold for duration specified below:

MH diameter (ft)	Duration (seconds)
4	60
5	75
6	90

3. Acceptable Vacuum Drop: Not more than 1 inch of Hq over the specified timeframe.

D. Exfiltration Test:

1. Plug pipes into and out of manhole and secure plugs.

2. Lower groundwater table (GWT) to below manhole. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.

3. Fill manhole with water to top of cone.

4. Allow a period of time for absorption (determined by Contractor).

5. Refill to top of cone.

6. Determine volume of leakage in an 8-hour minimum test period and calculate rate.

7. Acceptable Leakage Rate: Not more than 1 gallon per vertical foot per 24 hours.

3.4 REPAIRS:

A. Determine causes of all leaks and repair them. Perform the necessary earthwork if manhole has been backfilled.

B. Perform repairs using methods and material approved by the Engineer. Remove and replace or reconstruct manhole if necessary. Remove and replace defective sections if required by Engineer.

END OF SECTION 02570

SECTION 02930 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS:

A. The Conditions of the Contract and all Sections of Division are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK:

A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, and without limiting the generality thereof furnish and install the following:

1. Topsoil.

2. Seeding.

3. Sodding.

B. Related Work Specified Elsewhere: Carefully examine all Contract Documents for requirements which affect the work of this Section. Other specifications sections which directly relate to the work of this section include, but are not limited to the following:

1. Stripping of Topsoil: Section 02100 - Site Preparation.

2. Establishment of Subgrade Elevation: Section 02200 - Earthwork.

1.3 QUALITY ASSURANCE; SUBMITTALS:

A. General: Comply with requirements of Section 01340-Quality Assurance; Submittals.

B. Reference Standards: Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, most restrictive requirements govern.

1. American Society for Testing and Materials (ASTM): C136 Sieve Analysis of Fine and Coarse Aggregates, E11 Wire-Cloth Sieves for Testing Purposes

C. Manufacturers Product Data: Submit manufacturer's product data for following materials:

1. Aluminum Sulfate

2. Fertilizer

D. Certificates of Compliance: Submit labels from manufacturer's container certifying that product meets specified requirements, for the following materials:

1. Grass Seed

2. Ground Limestone

3. Commercial Fertilizer

1.4 INSPECTION AND TESTING:

A. Work will be subject to inspection at all times by Architect. Owner reserves the right to engage an independent testing laboratory in accordance with the requirements of Section 01400, Testing Laboratory Services, to analyze and test materials used in the construction of the work. Where directed by Architect, the testing laboratory will make material analyses and will report to Architect whether materials conform to the requirements of this specification.

1. Cost of initial tests and material analyses made by the Testing Laboratory will be borne by the Owner. Costs of retesting resulting from initial tests indicating non-compliance shall be borne by Contractor.

2. Testing equipment will be provided by and tests performed by Testing Laboratory. Upon request by Architect, Contractor shall provide such auxiliary personnel and services needed to accomplish the testing work and to repair damage caused thereby to the permanent work.

B. Testing, analyses, and inspection required by Contractor for own information or guidance shall be at Contractor's expense.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver seed in original sealed containers, labeled with analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, location of packaging, and name of seed grower. Damaged packages will not be accepted.

B. Deliver fertilizer in sealed waterproof bags, printed with manufacturer's name, weight, and guaranteed analysis.

1.6 PLANTING SEASON:

A. Planting season for seeding shall be as follows:

	Planting Period	
Item	Spring	Fall
Seed Mix - Lawn Grass	5/1 to 7/1	8/20 to 10/1

B. Perform planting only when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.

C. Planting season may be extended with written permission of Architect.

1.7 ACCEPTANCE:

A. Acceptance:

1. Architect will inspect all work for Substantial Completion upon written request of Contractor. Request shall be received at least ten calendar days before anticipated date of inspection.

2. Acceptance of material by Architect will be for general conformance to specified requirements, and shall not relieve Contractor of responsibility for full conformance to Contract Documents.

3. Upon completion and reinspection of all repairs or renewals necessary in the judgement of Architect, Architect will recommend to Owner that the work of this Section be accepted.

B. Seeded areas will be accepted only when in compliance with all the following conditions:

1. Roots are thoroughly knit to the soil;

2. All areas show a uniform stand of specified grass in healthy condition;

3. At least 60 days have elapsed since completion of work under this Section.

PART 2 - PRODUCTS

2.1 SEED:

A. Seed Mixture: Standard grade seed of the most recent season's crop, dry and free of mold, mixture as follows:

Name of Seed	% by Weight in Mixture	Minimum % Purity	Minimum % Germination
Pennlawn Creeping Red Fescue	50	98	90
Kentucky 31 Tall Fescue	30	95	90
Common Perennial Ryegrass	10	95	90
Red Top	5	90	95
Ladino Clover	5	85	96

2.2 TOPSOIL:

A. Obtain topsoil from a previously established stockpile on the site, to extent available. Obtain additional topsoil from Architect approved off-site sources. If on site topsoil is used, modify soil to meet the standards.

B. Topsoil, whether stripped from site or supplied from off-site, shall be a sandy loam or loam soil as defined by the USDA Soil Conservation Service, Soil Classification System, and shall have the following mechanical analysis:

Textural Class	% of Total Weight	Average
Sand (0.05-2.0 mm dia. range)	45 to 75	60
Silt (0.002-0.05 mm dia. range)	15 to 35	25
Clay (less than 0.002 mm dia. range)	5 to 25	15

1. 95% of topsoil shall pass a 2.0 mm sieve.

2. Topsoil shall be free of stones 1 inch in longest dimension, earth clods, plant parts, and debris.

3. Organic matter content shall be 4 to 8% of total dry weight.

C. Provide topsoil having a pH value range of 6.0 to 6.5. If the soil does not fall within the pH range specified, it may be amended to bring the pH within the specified limit.

2.3 PEAT MOSS:

A. Provide horticultural grade, sphagnum peat moss containing partially decomposed fibrous or cellular stems and leaves of any of the many species of sphagnum mosses from fresh water sources, conforming to following requirements:

1. Homogeneous material free of decomposed colloidal residue lumps, roots, stones, and other foreign matter; and of such consistency that peat can pass a 1/2 inch mesh and can be readily incorporated with the topsoil.

2. pH not less than 3.5 nor greater than 6.0 at 25 deg. C.

3. Organic matter content not less than 90%, by weight, on an oven-dry basis.

4. Ash content not more than 10%, by weight, on an oven-dry basis.

5. Moisture absorption capacity not less than 800%, by weight, on an oven-dry basis.

2.4 LIMESTONE:

A. Ground Limestone: An agricultural limestone containing minimum of 85% total carbonates, by weight, graded within the following limits:

Sieve Size	% Passing by Weight

No. 10	100	
No. 20	90	
No. 100		60

2.5 WATER:

A. Water shall be suitable for irrigation and free from ingredients harmful to seeded areas.

2.6 ALUMINUM SULFATE:

A. Aluminium sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer, and net weight of contents.

2.7 COMMERCIAL FERTILIZER:

A. Provide fertilizer conforming to the following:

1. When applied as a topsoil amendment, provide fertilizer having an analysis that will deliver appropriate amounts of nitrogen, phosphorus, and potassium as required to remedy deficiencies revealed by testing the topsoil.

2. When used as a top dressing for the maintenance of sod, conform to following:

a. 50% of nitrogen from natural organic source of ureafoam.

b. Available phosphorus derived from superphosphate, bone meal, or tankage.

c. Potassium derived from muriate of potash containing 60% potash.

B. Deliver fertilizer in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis.

C. Fertilizers with N-P-K analysis other than that stated above may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE:

A. Examine subgrade to assure that rough grading and all other subsurface work in lawn areas and other areas to be seeded is done prior to start of seeding.

B. Loosen existing subgrade or scarify to a minimum depth of 3 inches prior to spreading topsoil. Bring subgrade to true and uniform grade. Clear of stones greater than 3 inches, stocks, and other extraneous material.

3.2 SPREADING OF TOPSOIL:

A. Spread topsoil until it is possible to follow immediately or within 24 hours with seeding operations. If topsoil is spread prior to this time, cultivate to loosen soil prior to seeding.

B. Do not place soil when subgrade or topsoil material are frozen, excessively wet, or excessively dry.

C. Spread topsoil in a uniform layer, to a thickness which will compact to depth required to bring final lawn and grass surfaces to required elevation. Unless otherwise indicated, provide minimum topsoil depth of 6 inches.

D. Grade and smooth surfaces, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

3.3 APPLICATION OF FERTILIZER AND CONDITIONERS:

A. Apply fertilizer and conditioners at following rates:

1. Peat Moss: 1 inch thick.

2. Limestone: As required by test results of topsoil.

3. Fertilizer: As required by test results of topsoil.

B. Mixing with Topsoil:

1. Spread fertilizer and conditioners over entire lawn areas at application rates indicated above.

2. Uniformly and thoroughly mix material into top 4 inches of topsoil by discing, rototilling, or other approved method.

3.4 FINISH GRADING:

A. Provide final surface of topsoil immediately before seeding with +1/2 in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Remove stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, and fill resulting holes with topsoil, leaving a uniform planar surface.

B. Finish grade surface with a drag or rake. Round out all breaks in grade, smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable, if surface is scarified afterward.

C. In event of settlement, readjust work to required finished grade.

3.5 SEED APPLICATION:

A. Broadcast seed by means of an approved mechanical spreader, to give a uniform application at the following rates:

Seed	Application Rate lb/1,000 s.f.
Seed Mixture - Lawn Grass	4.5

B. Apply seed in two equal applications for uniform coverage; direction of travel of spreader for second pass perpendicular to that of the first pass. Do not seed when it is raining or snowing, or when wind velocity exceeds 5 mph.

1. At Contractor's option, and with the permission of Architect, seed may be spread by hydroseeding method, utilizing power equipment commonly used for that purpose. Mix and apply seed, lime, fertilizer, and mulch to achieve application quantities specified herein for the conventional seeding method, with mulch applied at the rate of 1,200 lb/acre. Other provisions specified for conventional seeding also apply to hyrdoseeding.

C. Protect seeded slopes greater than 1:2 against erosion with erosion netting or other methods acceptable to Architect.

D. Following seeding, lightly rake the area to mingle seed with top 1/8 to 1/4 in. of soil, then fine grade. Remove stones and other debris greater than 1 in. in any dimension which are visible on surface. Roll surface with hand roller having a weight of 60 to 90 lb/ft of width, and a minimum diameter of 2 feet.

E. Following seeding and raking, water entire area by use of lawn sprinklers, or other approved means. Continue initial watering until equivalent of a 2-in. depth of water has been applied to entire seeded surface, at rate which will not dislodge the seed. Repeat watering thereafter as frequent as required to prevent drying of the surface, until grass attains an average height of 1/4 in. Watering methods and apparatus which may cause erosion of the surfaces are not permitted.

3.6 MAINTENANCE:

A. Except as otherwise specified below, include all operations required to produce an established lawn, including but not limited to:

1. Fertilizing
2. Mowing
3. Replanting
4. Watering
5. Weeding

B. Begin maintenance of seeded areas upon completion of seeding and continue until acceptance of the building, until mowing as specified below is completed, or until average height of grass if 1-1/2 in., whichever occurs later.

C. After grass has sprouted, replace seeded areas which fail to show a uniform stand of grass as often as necessary to establish acceptable stand of grass.

1. Scattered bare spots shall not exceed 72 square inches each.

D. Do first mowing when average height of grass is 2-1/2 in., with mower set to cut at a height of 1-1/2 in. Perform subsequent mowings at not over two week intervals, with height of cut set at 1-

1/2 in. With prior permission of owner, mowings during periods of slow growth or dormancy may be spaced at greater intervals.

E. Remove weed sand growth other than varieties of grass named in grass seed formula. Removal may be accomplished by use of suitable herbicides or by physical removal, in which case remove both top growth and roots, and reseed bare spots exceeding specified limits.

F. If lawn or grass is established in the fall maintenance is required to continue into spring months. Provide an extra application of lime and fertilizer to lawn and grass in the spring. Spread lime and fertilizer in a uniform layer over entire lawn surface, at following rates:

Material	Application Rate
Lime	100 lb/1000 sf
Fertilizer	20 lb/1000 sf

END OF SECTION 02930

SECTION 02950 - LANDSCAPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. General: Provide and install all trees and shrubs as shown on drawings. This work includes preparation of subsoil, planting, protection and maintenance of the plant materials.

1.2 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02930 - Lawns and Grasses

1.3 QUALITY ASSURANCE

A. Standards: ANSI - Z60.1 "American Standards for Nursery Stock".

B. Subcontract landscape work to a single firm specializing in landscape work.

C. Do not make substitutions. If specialized landscape materials is not obtainable, submit proof or non-availability to Engineer, together with proposal for use of equivalent material.

Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

Topsoil: Before delivery of topsoil, furnish Engineer with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years.

D. Trees, Shrubs, and Plants: Provide trees and shrubs of quantity, size, genus, species, and variety shown and scheduled for landscape work.

E. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

1. 4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Plant and Material Certifications:

1. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.

2. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.

C. Planting Schedule: Indicate dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

D. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

1.5 DELIVERY, STORAGE AND HANDLING

A. Trees and Shrubs: Provide freshly dug trees and shrubs or those in containers for at least one season. Provide protective covering during delivery, cover to protect from wind exposure during delivery. Do not drop balled and burlapped stock during delivery.

B. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

C. Do not remove container-grown stock from containers until planting time.

1.6 JOB CONDITIONS

A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Do not install plants when ambient temperatures go below 35 degrees F. or above 90 degrees F.

C. Do not install plants when wind velocity exceeds 30 mph.

1.7 SEQUENCING AND SCHEDULING

A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available.

B. Plant or install materials during normal planting seasons for each type of plant material required.

C. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

1. 8 PROJECT WARRANTY

A. Warranty trees and shrubs, for a period of one year after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusually phenomena or incidents which are beyond Landscape Installer's control.

B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period.

C. A warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. General: Use topsoil as provided in Section 02930 - Lawns and Grasses.

2.2 SOIL AMENDMENTS

A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

B. Aluminum Sulfate: Commercial grade.

C. Peat Humus: Finely divided peat, so completely decomposed and free of fibers that its biological identity is lost. Provide in granular form, free of hard lumps and with pH range suitable for intended use.

D. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.

E. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.

F. Sand: Clean, washed sand, free of toxic materials.

G. Perlite: Conforming to National Bureau of Standards PS 23.

H. Vermiculite: Horticulture grade, free of toxic substances.

I. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil, or toxic substances and with 7.5 pounds of nitrogen uniformly mixed into each cubic yard of sawdust.

J. Manure: Well rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust or other bedding materials and containing no chemicals or ingredients harmful to plants.

K. Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees or shrubs, and consisting of ground or shredded bark.

L. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:

1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid and 5 percent soluble potash.

M. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of plants.

2.3 PLANT MATERIALS

A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

1. Provide balled and burlapped (B&B) deciduous trees.

2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.

C. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

1. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.

D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum height. Provide normal quality evergreens with well balanced form.

1. Provide balled and burlapped (B&B) evergreens.

2. Container grown evergreens will be acceptable, subject to specified limitations for container grown stock.

E. Miscellaneous Landscape Materials:

1. Anti-Erosion Mulch: Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.

2. Wrapping: Tree-wrap tape not less than 4 inches wide, designed to prevent borer damage and winter freezing.

3. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood, or redwood, free of knot holes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 ga. with zinc-coated turnbuckles. Provide not less than 1/2 inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.

PART 3 - EXECUTION

3.1 PREPARATION OF PLANTING SOIL

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

1. Mix lime with dry soil prior to mixing of fertilizer.

2. Prevent lime from contacting roots or acid-loving plants.

3. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

3.2 PREPARATION OF PLANTING BEDS

A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.

B. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevation shown, after light rolling and natural settlement. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.

3.3 EXCAVATION FOR TREES AND SHRUBS

A. Excavate pits and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. For balled and burlapped (B&B trees and shrubs), make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:

   Allow for 3 inch thick setting layer of planting soil mixture.

2. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

3.4 PLANTING TREES AND SHRUBS

A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.

B. Set container grown stock, as specified, for balled burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.

C. Dish top of backfill to allow for mulching.

Mulch pits, trenches, and planted areas. Provide not less than 4" thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.

D. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Do not cut tree leaders. Remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.

E. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

F. Wrap tree trunks of 2 inches caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures before wrapping.

G. Guy and stake trees immediately after planting, as indicated.

3.5 MAINTENANCE

A. Begin maintenance immediately after pruning.

B. Maintain trees, shrubs, and other plants until final acceptance.

C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

3.6 CLEANUP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 INSPECTION AND ACCEPTANCE

A. When landscape work is completed, including maintenance, Engineer will, upon request, make an inspection to determine acceptability.

1. Landscape work may be inspected for acceptance in portions provided each portion of work offered for inspection is complete, including maintenance.

When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Engineer and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION 02950

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. If the Contractor discovers any ambiguity, error, omission, conflict, or discrepancy, Special Provision Section 101.3.6 Priority of Contract Documents shall control.

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
2. State of Maine Department of Transportation, "Standard Specifications," Revision 2002, apply to this Section.
   a. This section shall supercede State of Maine Department of Transportation, "Standard Specifications section 502, except as noted herein.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes, and under slab vapor barrier system.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 REFERENCES

A. American Concrete Institute (ACI):

1. 117 - Specifications for Tolerances for Concrete Construction and Materials
2. 301 - Specifications for Structural Concrete for Buildings
3. 305R - Hot Weather Concreting
4. 306R - Cold Weather Concreting
5. 309R - Guide for Consolidation of Concrete
6. 315 - Manual of Standard Practice for Detailing Reinforced Concrete
7. 347 - Recommended Practice for Concrete Formwork
8. 318 - Building Code Requirements for Reinforced Concrete
9. 544.1R - State-of-the-Art Report of Fiber Reinforced Concrete

10. 554.2R - Measurement of Properties of Fiber Reinforced Concrete

B. American Society for Testing and Materials (ASTM):

1. A 185 - Welded Steel Wire Fabric for Concrete Reinforcement
2. A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3. C 33 - Concrete Aggregate
4. C 39 - Compressive Strength of Cylindrical Concrete Specimens
5. C 94 - Ready-Mixed Cement
6. C 150 - Portland Cement
7. C 260 - Air-Entraining Admixtures for Concrete
8. C 309 - Liquid Membrane-Forming Compounds for Curing Concrete
9. C 494 - Chemical Admixtures for Concrete
10. C 1018 Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
11. C 1116 - Type III, Sections 4.1.3 and 4.2, and Performance Level I, Toughness Index I5 outlined in Section 21, Note 17, Standard Specification for Fiber-Reinforced Concrete and Shotcrete

C. Federal Specifications (FS):

1. TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI - Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars (MSP-latest edition)

E. American Welding Society (AWS)

F. Scaffolding and Shoring Institute (SSI):

1. Scaffolding and Shoring Safety Rules

1.5 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Provide cement manufacturer's letter of certification and chemical content test results stating that the Portland cement is in compliance with ASTM designation C 150.
2. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Flatwork Certificates: Copies of supervisors "ACI Concrete Flatwork Technician" certificate.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

G. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Waterstops.
6. Curing materials.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Epoxy joint filler.
12. Joint-filler strips.
13. Repair materials.

H. Minutes of Preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the Department of Transportation's "Certificate of Ready Mixed Concrete Production Facilities".
2. Owner shall provide all concrete material testing and concrete cylinder samples for this project. Contractor shall coordinate schedule of installations with the Owner to allow ample time for the owner to schedule appropriate testing.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

E. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Preinstallation Conference: The contractor shall Conduct conference at Project.

1. Flatwork (interior and exterior slabs) Preinstallation Conference: Conduct conference at Project site to review all details and requirements for the batching, mixing, transporting, placing, finishing, and curing all interior and exterior flatwork operations. Require representatives of each entity directly concerned with flatwork operation to attend, including the following:

a. Contractor and Contractor's superintendent.
b. Ready-mix concrete producer.
c. Flatwork subcontractors.
d. Maine Department of Transportation's representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1, or better.
b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
c. Structural 1, B-B, or better, mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.

2. Manufactured forming system: metal or other panel system with prior review and approval.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

1. Bars shall be clean and free from rust, scale or coatings that will reduce bond. Reinforcing steel shall be capable of bending 180 degrees and rebending to original shape without fracture.

B. Plain-Steel Wire: ASTM A 82, as drawn.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or fiber-reinforced concrete of greater compressive strength than concrete.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Nominal Maximum Aggregate Size: 3/4 inch (19 mm).

C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260. The material used shall be one of the products listed on the Maine Department of Transportation's Approved Product List.

C. Water-Reducing Admixture: ASTM C 494, Type A. The material used shall be one of the products listed on the Maine Department of Transportation's Approved Product List.

D. Non-Corrosive Accelerator: ASTM C 494, Type C or E, The material used shall be one of the products listed on the Maine Department of Transportation's Approved Product List .

a. Non –corrosive accelerator shall have long-term test data proving its non-corrosive effect on reinforcing steel.

2.6 FIBER REINFORCEMENT

A. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long. "Fibermesh" by Fibermesh, Division of Synthetic Industries.

2.7 WATERSTOPS

A. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete. Parastop II by Paramount Technical Products, Inc. or approved equal.

2.8 VAPOR RETARDERS

A. Vapor Retarder: Provide water-resistant barrier consisting of high density, polyethylene meeting the following specifications:
1. Water Vapor Transmission: 0.006 gr./sq.ft./hr per ASTM E96.
2. Permeance Rating: 0.01 gr./sq.ft./hr per ASTM E96.
3. Puncture Resistance: 204 lbs/sq.ft. per GRI-GS-1-86.
4. Tensile Strength: 54.2 lbs. @ 1139% strain/MD and 55.5 lbs. @ 1009% strain/CMD per ASTM D638.
5. Tear Resistance: 7.40 lbs/ft. MD and 8.22 lbs/ft. CMD per ASTM D1004.
6. Low Temperature Brittleness: Pass both machine direction and cross machine direction per ASTM D1790 (15 min. @ 15 deg F.)
7. Meets to ASTM E 1745, Class A and B standards for underslab vapor retarders.
8. Product: Subject to compliance with requirements, provide Stego Wrap by Stego Industries, LLC, 15 mil thick vapor retarder. (877) 464-7834.

2.9 CURING MATERIALS

A. Curing materials shall be in accordance with State of Maine Department of Transportation, "Standard Specifications," Revision 2002 section 701.06

2.9 RELATED MATERIALS

A. Perimeter Isolation Joint: 2 lb. density, cross linked polyethylene with removable strip-off equal to ISO-STRIP as manufactured for Century Floors, Topsham, Maine.

B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

C. Deicer Protection (Exterior Concrete): Saltgard as manufactured by Pro So Co, Inc., or approved equal.

D. Water and Oil Repellent: A clear penetrating silane compound with oil repellency additives. Water and oil repellent shall be Sure Klean Weather Seal SLX100 as manufactured by Pro So Co, Inc. or approved equal.

E. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy-Bonding Adhesive: A two-component, solvent-free, moisture-insensitive structural epoxy adhesive in compliance with ASTM C 881, Type I and Type II, Grade 2, Class B and C, and shall be Sikadur 32, Hi-Mod by Sika Corp. or approved equal.

G. Doweling Adhesive: A two-component, vinylester blend resin equal to HI HY150 adhesive as manufactured by Hilti Fastening Systems, Tulsa, Oklahoma or approved equal.

H. Floor Control: Control joints shall be saw cut or 1/4" wide soft-cut.

I. Construction Joints: See Drawing Details.

J. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water-reducing and plasticizing agents capable of minimum compression strength of 2,400 lbs. Non-shrink grout shall be "Eucon N-S" (non-metallic) by the Euclid Chemical Co., "Masterflow 713" (non-metallic) by Master Builders, Five Star Grout by U.S. Grout Corp., or approved equal.

2.10 REPAIR MATERIALS

A. Slurry: Slurry shall consist of the same proportions of cement to fine aggregates used in the regular concrete mix (coarse aggregate only omitted) and shall be well mixed with such amount of water as will produce a thick consistency.

B. Dry Pack: Dry pack for cosmetic concrete repairs only shall consist of one part cement to 2-1/2 parts fine aggregate (screen out all materials retained on No. 4 sieve), mixed with a minimum amount of water, in small amounts. The consistency shall be such that when a ball of the mixture is compressed in the hand it will maintain its shape, showing finger marks, but without showing any surface water.

C. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

D. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Table for Working Stress Concrete:

USE	STRENGTH 28 DAYS	MAXIMUM SIZE COARSE AGGREGATE	CEMENT MAXIMUM SLUMP AT PLACEMENT	WEIGHT OF CEMENT	TYPE OF CEMENT	WATER-CEMENT RATIO
Walls, Footings & Pads	3500#/sq. in.	3/4"	2"-4"	517#	II	0.53
Interior Slabs on Grade	4000#/sq. in.	3/4"	2"-4"	517#	II	0.53
Exterior Slabs on Grade, Sidewalks, & Related Work	4000#/sq. in.	3/4"	4"	611#	II	0.55

D. All concrete shall contain the specified water-reducing admixture. All slabs placed below 50 degrees F shall contain the specified non-corrosive accelerator. All exterior concrete shall contain an approved air-entraining admixture.

E. All exterior concrete shall have an air content of five percent to seven percent.

F. All exterior concrete subjected to freezing and thawing shall have a maximum water-cement ratio of 0.53. All concrete subjected to deicers shall have a maximum water-cement ratio of 0.45.

G. All mix design, batching, placing, finishing, curing, joint sealing and patching of color conditioned concrete shall be in strict accordance with the manufacturers recommendations

H. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

I. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content: 6 percent for 3/4-inch- (19-mm-) nominal maximum aggregate size.

J. Do not air entrain concrete to trowel-finished interior floors. Do not allow entrapped air content to exceed 3 percent.

K. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

L. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. yd. (0.60 kg/cu. m).

M. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information (floor slabs only).

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

1. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Excessive deflection of forms after concrete is poured shall be sufficient cause for rejection of that portion of concrete and formwork. Excessive deflection will be considered to be that which will produce visible and noticeable waves in the finished concrete.
2. Construct forms so that walls will key into each other at ends unless poured monolithically.

B. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm). (Exposed concrete)
2. Class B, 1/4 inch (6 mm). (Non-exposed concrete)

C. Construct forms tight enough to prevent loss of concrete mortar.

D. All possible care shall be taken in the formwork to produce surfaces free from honeycomb or other defects.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Schedule the work and notify other trades in time so that provisions for their work in the formwork can be made without delaying progress of the project. Verify that all sleeves, pipes, etc., for electrical, plumbing, heating and ventilation, or other work are installed.

H. Chamfer exterior corners and edges of permanently exposed concrete, where indicated on drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Bolts, rods or other approved devices shall be used for internal ties. They shall be so arranged that when the forms are removed, no metal shall be within 1" of any surface.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Secure information about and provide for all openings, offsets, recessed nailing blocks, channel chases, anchors, ties, inserts, etc., in the formwork before concrete is poured.
2. Install anchor bolts, accurately located, to elevations required.

a. The setting of all anchor bolts and the grouting for all structural steel base plates shall be included as part of this contract. Bolts and base plates will be furnished under Section 05500 - Metal Fabrications, and Section 13125 – Metal Building Systems.
b. All column base plates, equipment bases, and other locations noted in the structural drawings shall be grouted with the specified non-shrink grout. All exposed grout shall be the specified non-metallic type.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 MOISTURE VAPOR RETARDER SYSTEM (UNDER FLOOR SLABS)

A. Moisture vapor retarder system shall be installed at all interior floor slabs and as otherwise indicated in the drawings in strict accordance with the manufacturer's printed instructions and as follows.

1. Snap chalk line along inside perimeter of foundation walls at top of slab elevation.

2. Without wetting, clean a 3" wide band on the surface of the concrete below the chalk line at approximately mid-slab height. Remove dirt, residual form release, or other bond inhibiting surface contaminates. Grind smooth any surface projections within the band.
3. While removing the contact paper on the backside, firmly press 2" wide manufacturer's approved perimeter and penetration strip onto wall, parallel to the chalk line on the cleaned band at mid-slab elevation.
4. Remove contact paper on the face side.
5. Apply 12" wide manufacturer's approved edge roll covering only the bottom 1" of contact surface on the perimeter strip. Cut, fit, and seal corner details with manufacturer's approved seaming tape.
6. Align top edge of isolation joint material to chalk line, and press material onto remaining 1" of exposed perimeter strip adhesive.
7. Roll out Vapor Barrier material, overlapping edge rolls and all seams by 3". Tape all seams with manufacturer's approved seaming tape.
8. All tears, punctures, etc. to be repaired and taped as required to maintain the watertight integrity of the vapor barrier system.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. All steel bars and wire shall be of size, gauge and length indicated, accurately bent or formed to shapes detailed or scheduled by experienced shops using methods that will not injure the materials.
2. Steel reinforcing shall not be bent in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the plans shall not be used. Heating of reinforcement for bending will not be permitted. Bars shall be bent once only (no rebending or straightening allowed) unless shown as such on the drawings.
3. All details of reinforcement not shown or indicated on the drawings or specifically called for in the specifications shall conform to ACI 315.
4. Lap all bars at splices, corners and intersections a minimum of 36 bar diameters unless otherwise indicated.
5. All intersecting concrete walls shall be tied with #4L bars 3'-0" long, bent 18" x 18" spaced 12" on center, outside face only unless otherwise indicated.
6. Splices of reinforcement shall not be made at points of maximum stress. Splice lengths shall be a minimum of 36 bar diameters unless otherwise indicated and shall provide sufficient lap to transfer the stress between bars by bond and shear. Stagger splices of adjacent bars where possible. All splices and laps at corners and intersections shall be tied with wire at each end.
7. Where obstructions (pipes, conduit, ducts, etc.) prevent the intended placement of reinforcing, provide additional reinforcing as directed by the Engineer or his Representative around the obstruction to match that reinforcing interrupted.
8. Provide additional stirrups, ties, trim bars, etc., as directed around all openings, sleeves, pipes, and conduits, which pass through structural elements.
9. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.Accurately position, support, and secure reinforcement against displacement. Locate

and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Coverage of bars (including stirrups and column ties) shall, unless otherwise shown, be as follows:

Footings:	3" soil face, 2" top
Slabs (on grade):	2" soil face, 1-1/2" top face
Slabs (elevated):	1" top and bottom
Beam and Column (piers)	1-1/2"
Walls:	2" clear to form at exterior

2. Misplaced Reinforcing: If any reinforcing bars are found to be misplaced after concrete has been placed, the Engineer shall be notified immediately and no correction or cutting shall be made without his direction. Misplaced bars shall not be bent or kinked. Any redesign and/or reinforcing required because of misplaced bars shall be at the Contractor's expense.
3. All reinforcing shall be kept separate from soil, pipe, conduit ducts, etc., by approved non-metallic separators.
4. Reinforcement shall not have welded joints unless indicated on the drawings or unless prior approval has been given by the Engineer. Welding shall conform to the requirements of the American Welding Society Structural Welding Code for reinforcing steel D1.4. Field welding shall be performed by AWS certified welders.
5. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
2. Space vertical joints in walls as indicated.

   a. Wall control "V" joints shall have a depth of 1/8 times the thickness of the wall and be 1/2" wide at surface. "V" joints shall be placed as shown or as directed by the Engineer.

3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, or 3/4" minimum for soff-cut as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4" (maximum) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

   a. Floor slab control joints shall be placed as shown on the foundation plan. Unless otherwise noted, control joints shall be spaced at intervals not to exceed 18'-0" on center in both directions.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.

1. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. All intersecting slab construction joints acting as control joints shall be doweled according to the following schedule unless otherwise indicated. Dowels shall be smooth, steel grade 60 with saw cut ends. Grease, wrap or cap one end.

Dowel Schedule

	Dowel Dia.	Length	Spacing
5" Slab	5/8"	14"	12"
6" Slab	3/4"	14"	12"
8" Slab	1"	14"	12"

3.8 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

1. Remove all protrusions and indentations 2" or over in all areas.
2. Lay waterstop flat against concrete surface and nail every 1" to 6" with case hardened washered nails.
3. Overlap all joints a minimum of 2".

3.9 MIXING CONCRETE

A. General: The concrete shall be mixed in the quantities required for immediate use, and any which has developed initial set or exceed the time limit of ASTM C 94 shall not be used. No retempering of mortar or concrete shall be allowed under any circumstances. Concrete shall be proportioned, mixed and placed only in the presence of the Engineer or his Authorized Representative. The Contractor shall give ample notice to the Engineer before mixing is commenced. Aggregate size will be adjusted to suit conditions of work. Pumping of concrete shall be permitted only after approval by the Engineer of the Pumping Contractor and the pumping equipment and method to be employed. The Engineer shall be notified of dates when pumping of concrete shall be performed to permit his on-the-job inspection of the operations.

B. Final proportions shall be in accordance with approved mix designs. Adjustments to approved proportions, for whatever reason, shall be approved by the Engineer.

C. Add fibrous concrete reinforcing to all concrete used at slabs interior and exterior on grade.

3.10 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Remove loose dirt, mud, standing water, and foreign matter from excavations or from cavities.

C. Thoroughly clean reinforcement and other embedded items free from loose rust and other matter. Assure reinforcing is held securely in place.

D. Thoroughly wet wood forms (except coated plywood), bottom and sides of trenches, base underslab, and adjacent concrete or masonry at least one hour in advance of placing concrete; securely close cleanout and inspection ports; repeat wetting as necessary to keep forms damp.

E. Equipment shall be maintained clean and of sufficient quantity and capacity to efficiently execute the work required.

F. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer.

G. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.

H. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

I. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

    a. Concrete shall be vibrated into final position in forms with an internal type vibrating machine. The vibration shall have a frequency of not less than 8,000 vibrations per minute. The mechanical vibrating equipment shall be satisfactory to the Engineer.
    b. The vibration shall be of sufficient intensity and duration to cause flow or settlement of the concrete and complete consolidation. Over vibration, especially of mixtures that are too wet, may cause segregation and will be avoided. A sufficient number of vibrators shall be provided to permit consolidation of each batch before the next batch is delivered and without delaying the delivery.
    c. The vibrations shall be applied directly to the concrete, and vibration through the forms shall not be permitted. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The concrete shall be placed in layers of uniform thickness
    d. Dropping of concrete a distance of more than 6 feet unless confined by closed chutes or pipes will not be permitted. The concrete shall be deposited at or as near as possible to its final position.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
3. When conditions make puddling difficult, or where the reinforcement is congested, batches of mortar containing the same proportions of cement to sand used in the concrete shall be deposited in the forms. The operation of filling with the regularly specified mix shall be carried on at such a rate that the mix is at all times plastic and flows readily into the spaces between the bars.
4. In thin walls or inaccessible portions of the forms where rodding is impractical, the concrete shall be worked into place by tapping or hammering forms adjacent to the freshly deposited concrete.
5. The Contractor's attention is called to the importance of making the concrete dense, and he shall provide sufficient labor to the entire satisfaction of the Engineer to thoroughly consolidate the concrete, avoid air pockets and voids in exposed sections, and leave smooth, uniform surfaces after forms are removed.
6. Should any honeycombed concrete be disclosed upon removal of forms, the Contractor shall immediately cut out the said honeycombed portions back to solid concrete and shall fill the opening thus formed with a concrete of the same proportions as that specified for the section of work in which the fault occurs.
7. When placing fresh concrete upon hardened concrete, the latter shall be thoroughly roughened and cleaned of all loose material, scum or latency. The bonding compound shall be applied and the new concrete placed while the bonding compound is still tacky.
8. Joints in the concrete work shall be made only in places and the manner specified by the Engineer.
9. The Contractor's attention is called to the importance of properly and carefully placing concrete around reinforcement, as the reinforcing metal must not be exposed; and in cases where reinforcing metal becomes exposed on the surface, that portion of work must

be removed and re-laid as the covering of same by plastering with cement mortar will not be allowed. All reinforcing rods or other reinforcing material shall be lightly tapped so that they will retain their original position.

10. No concrete shall be retempered except as allowed in ASTM C 94 nor shall set concrete be used as aggregate.

J. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.

    a. Reinforcement, unless otherwise indicated, shall be placed one-half the thickness of the slab.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
6. In addition to steel bar reinforcement, slabs shall be reinforced with fibrous concrete reinforcement which is to be added when the concrete is being batched in strict accordance with the manufacturer's recommendations.
7. Slabs shall be monolithically placed with control joints. Sawed control joints will be located as indicated on the drawings and/or as directed by the Engineer. Floors shall be cleaned of objects before saw cutting begins. A true, continuous saw cut is what is expected as a finish result.

K. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
4. Contractor shall have on the job, ready to install, adequate equipment for heating the materials and the freshly placed concrete and for enclosing the work in accordance with the requirements specified herein.

L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control

temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

M. Protection:

1. Concrete just placed shall be protected from rain in an approved manner until the concrete has set, or if a slab, the curing compound has dried.
2. Concrete, when placed in the forms, shall have a temperature of not less than 50 degrees F nor more than 90 degrees F. Freshly placed concrete and the surrounding air shall be maintained at a temperature of 50 degrees F or greater for a period of seven days after placing. If high early strength concrete is used, the aforementioned time period may be reduced to three days. The methods of protection and curing shall be such as to prevent evaporation of moisture from the concrete and injury to the surface.
3. Should it later develop that any concrete work has become injured in any way by freezing or otherwise, the defective concrete shall be repaired or replaced as directed by the Engineer at no added expense to the Owner. Repair materials shall include all reinforcement grouts, dry pack, admixtures, epoxy and aggregates as may be necessary

N. Deicer Protection:

1. Apply deicer protection to all exterior slabs on grade, and related work 30 days after concrete placement in strict accordance with manufacturer's written recommendations.

3.11 PROTECTIVE COATING FOR STRUCTURAL STEEL

A. All structural steel columns and their bases which extend into or through concrete floors shall be thoroughly brush painted with two coats of foundation coating as specified in Section 07150 - Dampproofing, and applied in accordance with the manufacturer's directions, neatly cut off one inch below finish floor.

3.12 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.13 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. All interior concrete floor slabs shall be finished true and smooth by steel troweling or finishing machine. All exterior slabs shall be broom finished.
2. When a section of the concrete floor is completed, it shall be left entirely undisturbed until the concrete is thoroughly hardened.
3. Adequate provisions will be made to eliminate the possibility of accidental encroachment upon the newly concreted area.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view.
2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

a. Tolerances will be in accordance with ACI Publication #117 - Class AX. Depression in floor between high spots shall not be greater than 3/16" in 10'-0" $\pm$ 1/16", and the measurement will be taken by the straight edge method no later than the day after the concrete floor has been poured.

D. Broom Finish: Apply a broom finish to exterior concrete platforms.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Mechanical Equipment Pads: Provide 4" concrete pads reinforced with #3 Bars at 12" O.C. each way under all mechanical equipment supported on concrete floor slab unless otherwise indicated.

C. Foundation Insulation: Install foundation insulation using a dab of emulsified asphalt mastic in each corner and the center to adhere the insulation to the concrete wall. Insulation will be installed on the inside face of all perimeter foundation walls extending from the underside of floor slab to top of footing. Insulation furnished under Section 07200 - Insulation.

3.15 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with State of Maine Department of Transportation, "Standard Specifications," Revision 2002 section 502.10.

3.16 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until the completion of the project. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

D. Install isolation joints around columns in accordance with the drawings and manufacturer's recommendations.

E. Install perimeter isolation joints in accordance with the drawings and manufacturer's recommendations.

3.17 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original

concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.18 FIELD QUALITY CONTROL

A. Testing Agency: Owner may perform verification tests or engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

1. The contractor shall be responsible to notify MDOT a minimum of 48 Hours prior to all required quality control testing.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. A set of four (4) test cylinders shall be made for each 100 cubic yards, or fraction thereof, of each class of concrete placed each day. Cylinders shall be made and cured by the Testing Agency in accordance with ASTM C 31. The properly marked cylinders shall be picked up by the approved testing agency and tested in accordance with ASTM C 39. The test results will be sent directly to the Engineer with location and date marked. In addition to the date cast, the date and time the cylinders are picked up for transportation to the lab shall be shown.
2. Description of the manner in which cylinders were stored for the first 24 hours and the succeeding 27 days shall also be indicated.
3. Air temperature, as well as the concrete temperature, shall be shown so that there is adequate data to evaluate varying and possibly low test results.
4. On-site slump tests will be made as directed:

    a. Type II Cement: At placement maximum slump 4", minimum slump 2"

5. Air content shall be checked at least twice each day on air-entrained concrete in accordance with ASTM C 173 or ASTM C 231.
6. The owner shall perform or pay for all tests.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

E. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.

END OF SECTION 03300

SECTION 04810 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:
1. Concrete masonry units.
2. Face brick.
3. Synthetic Polymer Masonry Units.
4. Mortar, grout, and coloring agents.
5. Reinforcing steel.
6. Masonry joint reinforcement.
7. Ties and anchors including dovetail anchors for securing masonry to Structural Steel Columns.
8. Embedded flashing.
9. Miscellaneous masonry accessories, including cavity drainage and venting products, and cleaning materials for new and existing Work.
10. Rigid, extruded polystyrene foam cavity-wall Insulation.
11. Concealed, formed metal flashing pans for heads of exterior wall openings.

B. Related Sections include the following:
1. Division 1 Section "Project Management and Coordination" for preinstallation conference requirements.
2. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
3. Division 7 Section "Through-penetration Firestop Systems" for firestopping at openings in and at tops of masonry walls.
4. Division 7 Section "Sheet Membrane Waterproofing" for water/vapor/air-barrier applied to exterior face of exterior perimeter back-up walls, both framed and masonry.
5.

C. Products installed, but not furnished, under this Section include the following:
1. Steel lintels for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Hollow-metal door and borrowed-lite frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

B. Hollow Masonry: All masonry units whether clay brick or CMU which contain cores, or cells of any percentage of the unit's overall volume.

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602

B. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314
   1. For Concrete Unit Masonry: f'm = 1,900 psi
   2. For Brick Unit Masonry: f'm = 2,000 psi

1.5 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Samples for Initial Selection: For the following:
   1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
   2. Colored mortar Samples showing the full range of colors available.

C. Samples for Verification: For the following:
   1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
   2. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
   3. Accessories embedded in the masonry.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
   1. Each type of masonry unit required.
   2. Each material and grade indicated for reinforcing bars.
   3. Each type and size of joint reinforcement.
   3. Each type and size of anchor, tie, and metal accessory.
   4. Accessory items of each type and application including drainage and vent products.

E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

C. Preinstallation Conference: Contact Designer two weeks prior to mobilization on the Project Site by masonry team to arrange preinstallation conference.

D. Mockups: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Locate mockups in the locations indicated or, if not indicated, as directed by Designer.
   2. Build mockups for the following types of masonry in sizes indicated below for wall type, by full thickness, including face and backup and accessories. Include a sealant-filled joint at least 16 inches long in each mockup for each type of joint to be expected in typical wall.
      a. Interior masonry with coursing and combination of unit types specified for interior exposed assembly. Mockup panel shall be not less than 60 inches long by 72 inches high.
      b. Typical exterior masonry veneer wall panel that includes a complete masonry opening detailed to match a window. Mock-up shall be complete with metal studs, sheathing, veneer ties, flashing, weep holes, vents, head pan, loose lintel, sealant joints, and synthetic polymer masonry units.
   3. Clean exposed faces of mockups with masonry cleaner as indicated.
   4. Notify Designer seven days in advance of dates and times when mockups will be constructed.
   5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   6. Approved mockups may become part of the completed Work for interior wall only, if undisturbed at time of Substantial Completion.

E. References: For comprehensive information on workmanship and procedures of "Best Practice" including details and materials to be employed in the construction of exterior brick veneer walls, refer to Brick Institute of America's *Technical Notes on Brick Construction.*
   1. Other applicable References: The following organizations, standards and/or guidelines also apply to the work of this Section.
      a. American Concrete Masonry Association - ACMA
      b. American Society for Testing and Materials - ASTM
      c. Society for Protective Coatings – SSPC

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units 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. If units become wet, do not install until they are dry.
   1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix (if employed) in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery

containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to un-constructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread 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 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 unit 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 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
   1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMU)

A. General: Provide shapes indicated and as follows:
   1. Provide bullnose units for outside corners, unless otherwise indicated.

2. Special shaped bond beam units of single- and double-course depth types as indicated.

B. Standard Concrete Masonry Units: ASTM C 90 and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi
2. Weight Classification: Normal weight.
3. Provide Type I, moisture-controlled units.
4. Shapes and Types:
a. CMU-1: Modular, standard, smooth-face CMU in full range of thicknesses with exposed face dimension for full-size units of 7-5/8" x 15-5/8".
b. CMU-2: Smooth-face with center vertical scored reveal where indicated on Drawings, required in a full range of thicknesses as indicated with exposed face dimension for full-size units of 7-5/8" x 15-5/8".
c. Where indicated and as required, provide shapes and styles of units including but not limited to, double and single bullnose as needed, sash block, soaps, solid units, various sized lintel and bond-beam units, and veneer blocks.

C. Synthetic Polymer Masonry Units (SMU): ASTM C-90 and as follows:
1. Basis-of-Design Product: The design intent requires the use of products named below or an equivalent. Subject to compliance with requirements, provide either the named product or comparable product by one of the other manufacturer's listed. If no others are listed, a comparable product may be submitted for Designer's approval.
a. Shouldice, "Designer Stone", Shallow Lake, Ontario, Canada, www.shouldice-stone.com .
b. Arriscraft Calcium Silicate Masonry Units matching the styles and sizes indicated below, as manufactured by Arriscraft International, Cambridge, Ontario, Canada, www.arriscraft.com.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900.
3. Class: Grade N, Type 1.
4. Texture and Finish: "Tapestry" Ground-face texture on exposed face(s) of all units. Provide all units with Non-Standard flush face profile without bevels or chamfers.
5. Color: Designer may use up to two of the Standard colors.
6. Size: Standard: 3-5/8 inches thick by 2-1/4 inches high by 8 inches long.

2.2 BRICK

A. General: Provide shapes indicated and as follows for each form of brick required:
1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.

B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Face Brick: ASTM C 216, Grade SW, Type FBS and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.

2. Initial Rate of Absorption: Less than 20 g per 30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
5. Size: Standard: 3-5/8 inches thick by 2-1/4 inches high by 8 inches long
6. Application: Use where brick is exposed, unless otherwise indicated.
7. Basis-of-Design Products: The design intent requires the use of products named below or an equivalent. Subject to compliance with requirements, provide either the named product or comparable product by one of the other manufacturer's listed. If no others are listed, a comparable product may be submitted for Designer's approval.
   a. Color and Texture: Match Morin-LaChance Old Port Full Range without darks.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207 Type S.

C. Aggregate for Grout: ASTM C 404.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
   1. Color Options: Up to four (4) different colors may be selected by Designer from manufacturer's full range of colors available.

E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

F. Water: Potable.

G. Manufacturer of Colored Portland Cement-Lime Pigments or Pre-Mix: Subject to compliance with requirements, provide products by one of the manufacturers listed:
   1. Color Mortar Blend; Glen-Gery Corporation.
   2. Centurion Colorbond PL; Lafarge Corporation.
   3. Lehigh Custom Color Portland/Lime; Lehigh Portland Cement Co.
   4. Solomon Grind System's H-Series mortar colormix.

2.4 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.

2.5 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:
   1. Hot-dip galvanized, carbon-steel wire for interior walls.
   2. Stainless-steel wire for exterior walls.

3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.

B. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

C. For multi-wythe masonry, provide types as follows:
1. Ladder type with perpendicular cross rods spaced not more than 16 inches o.c. and 1 side rod for each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod for each wythe of masonry 4 inches or less in width.
2. Tab type with single pair of side rods spaced for embedment within each face shell of backup wythe and rectangular box-type cross ties spaced not more than 16 inches o.c. Size ties to extend at least halfway through outer wythe but with at least 5/8-inch cover on outside face.
3. Adjustable (2-piece) type with single pair of side rods and cross ties spaced not more than 16 inches o.c. and with separate adjustable veneer ties engaging the cross ties. Cross ties are either U-shaped with eyes or rectangular. Space side rods for embedment within each face shell of backup wythe and size adjustable ties to extend at least halfway through outer wythe but with at least 5/8-inch cover on outside face.
   a. Use where indicated and where horizontal joints of facing wythe do not align with those of backup wythe.
   b. Use where facing wythe is of different material than backup wythe.

2.6 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Mill Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 641 , Class 1 coating.

C. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.

D. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304 or 316.

E. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 , commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication.

F. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

G. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316.

2.7 ADJUSTABLE MASONRY-VENEER ANCHORS

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch .

B. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie section and a metal anchor section complying with the following requirements:
   1. Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
      a. Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch .
      b. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.
   2. Fasteners: Self drilling and tapping screws shall be used that are recommended by manufacturer of, and compatible with ties specified below. Screws shall be machined from base metal and plated or epoxy coated to maximize corrosion resistance, or shall be stainless steel as required to eliminate galvanic action from dissimilar metals at studs and ties.

C. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or a comparable product upon approval of the Designer:
   1. DW-10-X; Hohmann & Barnard, Inc.

2.8 EMBEDDED FLASHING MATERIALS

A. Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified below. For flashing not exposed to the exterior, use the following, unless otherwise indicated:
   1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

B. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed. If no others listed, upon approval of the Designer:
   1. Copper-Laminated Flashing:
      a. H & B C-Fab Flashing; Hohmann & Barnard, Inc.
      b. York Flashing Copper Fabric; York Manufacturing, Inc. Sanford, ME

C. Formed Metal Pan Flashing for Heads of Openings through Veneer and Basepan/Dripstrip at Brickshelf of Foundation: Lead-Coated Copper, ASTM B101, cold-rolled copper sheet, not less than 16 oz./sq. ft., both sides coated with lead weighing not less than 12 nor more than 15 lb/100 sq. ft., unless otherwise indicated.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication.
   1. Provide units with either two loops or four loops as needed for number of bars indicated.

D. Cavity Drainage Material: 1-inch-thick, free-draining mesh; made from polyethylene strands and shaped in a dovetail profile to avoid being clogged by mortar droppings.
   1. Basis-of-Design Base-Bid Product: Subject to compliance with requirements, provide either Mortar Net; Mortar Net USA, Ltd. or a comparable product upon approval of the Designer:
      a. Size: Provide precut units in thickness indicated x 10 inches high x 60 inch length.

2.10 CLEANING MATERIALS AND EQUIPMENT:

A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter. Water will be available from building plumbing. Contractor shall supply provide pump(s) and all necessary hoses for use as necessary.
   1. Warm Water: Heat water to temperature of 140 deg.F - 180 deg.F (60 deg.C-82 deg.C).

B. Restoration Cleaning Agent: EK Restoration Cleaner by ProSoCo, Inc. with a pH of 5.5, or approved equal with similar properties for use on all existing brick to remain exposed on interior of spaces enclosed by additions.

C. Brushes: Fiber bristles only.

D. Acidic Cleaner: "Ultra - Safe Acid" Muriatic acid replacement shall be used for post-restoration and post-construction (new work) masonry cleaning.
   1. Job-Mixed Detergent Solution: In lieu of the product above, also acceptable for cleaning of brick masonry, a solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

2.11 MORTAR AND GROUT 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.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270 Proportion Specification.
   1. Mortar for all masonry work shall be Type C unless otherwise indicated.

D. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
   1. For mineral-oxide pigments and portland cement-lime mortar, not more than 10 percent.
   2. Colors: Allow for one colors of mortar. Color shall be as selected from manufacturer's full range of pigments available.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

2.12 EXTERIOR, MASONRY CAVITY INSULATION SYSTEM:

A. Extruded Polystyrene Board Insulation Manufacturers and Type:
1. Dow Chemical Company, "Cavity-Mate SC"
2. Owens Corning "Foamular"
3. Tenneco Building Products

B. General: For application over exterior gypsum sheathing in masonry wall air space, as uninterrupted exterior envelope insulation system; ASTM C578, Type X. Rigid, extruded polystyrene foam insulation board core.
1. Panel Edge: Shiplap edge profile.
   a. NOTE: All horizontal joints shall be shiplapped for drainage and moisture migration resistance. Cut edges or seams shall be routed to restore the shiplap profile.
2. Thickness: Boards shall be 1.5 inch thick.
3. R-value: Per ASTM C518, shall be not less than R-5 per inch of thickness.
4. Density: 1.60 lb/cu. ft.
5. Compressive strength of core foam shall be 25 psi.

C. Adhesive for Bonding Board Insulation to Supporting Surfaces: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
1. Fasteners: Where necessary for supplemental attachment security, employ corrosion resistant plated steel, self-drilling screws and plastic washers as recommended by foam panel manufacturer.

D. Board Insulation Joint Tape: Pressure-sensitive tape of type recommended by rigid foam insulation board manufacturer for sealing all joints and penetrations, equal to one of the following:
1. Carlisle Coatings and Waterproofing, Inc.; CCW-705
2. Polyguard Products, Inc.; Polyguard Tape
3. Protecto-wrap Company; Protecto Wrap BT20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions in areas of new Work, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Verify that foundations are within tolerances specified.
2. Verify that reinforcing dowels are properly placed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 PREPARATION FOR CLEANING AND EXISTING MASONRY MODIFICATIONS

A. Protect persons and surrounding surfaces of building whose masonry surfaces are being cleaned or impacted, building site, vehicles, and surrounding pavements from injury resulting from masonry cleaning or modification work.

B. All windows are designated to be replaced as part of the Work of this Project. Coordinate the masonry work with the proposed replacement activities of these elements. Perform masonry work adjacent to windows prior to replacement activities.

C. Contractor to provide all necessary staging and scaffolding to complete work in a safe and appropriate fashion, including crane or hoisting apparatus for placement of scaffolding adjacent to wall surfaces inaccessible from exterior finish grade.

D. Dispose of run-off from cleaning operations by legal means and in manner that prevents damage to landscaping, and water penetration into building interiors.

E. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles that must remain in operation during course of masonry cleaning work.

F. Remove loose mortar, soil or debris form open masonry joints to whatever depth it occurs.

3.3 BRICK REMOVAL AND REBUILDING:

A. Removal:

1. Carefully remove by mechanical, power tool means using masonry cutting blades designed for restoration joint cutting, within areas indicated. Cut out full units from joint to joint and in manner to permit replacement with full size units and throughout areas indicated to be required for flashing installations and to receive new work.
2. Support and protect masonry indicated to remain which surrounds removal area.
3. Remove mortar, loose particles and soil from salvaged brick to be reused, by cleaning with brushes and water. Store brick for reuse.
4. Clean remaining brick at edges of removal areas by removing mortar, dust, and loose debris in preparation for rebuilding.

B. Brick Rebuilding:

1. Install new or salvaged brick to replace removed brick. Where new brick must be used, the rebuilding mason shall carefully select brick from the specified blends to achieve a color palette matching the original brick in the area to be rebuilt, as exactly as possible. Fit replacement units into bonding and coursing pattern of existing brick. If cutting is required use motor driven saw designed to cut masonry with clean, sharp unchipped edges.
2. Lay replacement brick with completely filled bed, head and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet clay brick that have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods, which ensure that units are nearly saturated, but surfaces dry when laid. Maintain joint width for replacement units to match existing.
3. Tool exposed mortar joints in repaired areas to match existing joints of surrounding masonry construction, all slated for full repointing. Match joint profiles and design of original construction to the greatest extent possible and as detailed herein and in Drawings.

3.4 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Provide 1-inch cavity between brick veneer and stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix new units from several pallets or cubes as they are placed.

G. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.5 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet , nor 1/2 inch maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet , nor 1/2 inch maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet , nor 1/2 inch maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch , with a maximum thickness limited to 1/2 inch . Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch .

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch . Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch .

3.6 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid

using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond patterns; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. Unless otherwise indicated, one-half running bond with vertical joint in each course centered on units in courses above and below.
   2. Stack bond has been indicated in specific locations on the building interior, for a texture and masonry coursing variation to add interest.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches . Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. At fire-rated partitions, construct and top off walls according to details, Partition Type descriptions on Drawings, and in conformance with UL Listed and tested system as necessary.

3.7 MORTAR BEDDING AND JOINTING

A. Lay masonry units as follows:
   1. With full mortar coverage on horizontal and vertical faces or face shells.
      a. Exterior brick veneer shall be placed in conformance with *Technical Notes 7 and 7B – Water Resistance of Brick Masonry, Construction and Workmanship.*
   2. Bed full unit and webs of hollow CMU in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells. Coordinate grouting requirements with structural details. All masonry units placed below finish floor at slabs-on-grade shall be grouted solid.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
   1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
   2. For Scored CMU – Exposed face shall have joints raked.

C. Cut joints flush for masonry walls to receive plaster, furring, or other direct-applied finishes (other than paint), unless otherwise indicated.

3.8 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
   1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

B. Insulation Installation – General
   1. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
   2. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
   3. Extend insulation in thickness indicated to envelope entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
   4. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.
   5. Install board insulation in cavity-wall construction throughout Project where masonry cavity-wall construction is indicated on Drawings. Adhere boards to exterior wall sheathing or back-up masonry wall according to insulation manufacturer's written instructions. Stagger joints of insulation from those of the sheathing substrate where feasible.
      a. Retain insulation in place by full surface adhesive application, or spindle-type anchors spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without damaging sheathing. Maintain cavity width (airspace) dimension indicated between insulation and masonry veneer.
      b. NOTE: All horizontal joints shall be shiplapped for drainage and moisture migration resistance. Cut edges of boards shall be routed to restore the shiplap profile.
      c. Seal all butt joints and penetrations of rigid board insulation with specified joint tape according to insulation and tape manufacturer's instructions. Seal fastener penetrations with tape where possible.

3.9 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches .
   1. Space reinforcement not more than 16 inches o.c.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing masonry-veneer anchors to comply with the following requirements:
   1. Fasten each anchor section through sheathing to wall framing with two metal fasteners of type indicated.
   2. Insert anchor sections in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches , around the perimeter.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake joints in exposed faces.

C. Form expansion joints in brick as follows:
   1. Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants." Keep joint free and clear of mortar. Form slip joint for steel lintels installed at door and window heads.

D. Build in horizontal, pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.12 LINTELS

A. Install steel lintels where indicated. Coordinate sizes of lintels with approved shop drawings and respective openings. All exterior lintels are to be galvanized and interior units primed.

B. Provide minimum bearing of 6 inches at each jamb, unless otherwise indicated.

3.13 STEEL LINTEL (EXISTING) RESTORATION

A. All existing steel lintels shall remain unless otherwise indicated in Drawings and shall be restored as follows:
   1. Rake joints in which lintel is located and expose all edges of steel possible.
   2. Remove all rust, corrosion, scale and paint from exposed steel of lintels using hand and/or blast cleaning methods protecting adjacent surfaces and materials as necessary.

a. Achieve SSPC – SP2 level of preparation to receive primer specified in other Sections of these Specifications.

3.14 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:
1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches , and behind air-infiltration barrier or building paper.
2. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads of openings through the exterior veneer, install formed metal pans with full coverage of the lintel spanning the opening. At sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
3. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.

D. Install weep holes with open head joints in exterior wythes of the first course of masonry immediately above embedded flashing.
1. Space weep holes 24 inches o.c. maximum unless otherwise noted.
2. Place cavity drainage material immediately above flashing in cavities.
3. Install vent holes at top of wall spaced and located to match weeps at bottom.

3.15 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
3. During construction, the concrete masonry unit walls shall be braced in accordance with the standard practice for bracing masonry walls under construction document developed by the council for masonry wall bracing, dated July 2001.

B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.16 FIELD QUALITY CONTROL

A. Testing Frequency: Tests and Evaluations listed in this Article shall be performed during construction for each 5000 sq. ft. of wall area or portion thereof.

B. Mortar properties will be tested per ASTM C 780

C. Grout will be sampled and tested for compressive strength per ASTM C 1019

D. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

E. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.17 REPAIRING, POINTING, AND CLEANING (NEW WORK)

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
   5. Clean brick, precast concrete, and stone by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution or acid free proprietary product specified, applied according to manufacturer's written instructions.
   7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.16 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04810

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Structural steel Shapes, plates and angles
   2. Beams
   3. Columns

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
   2. Division 5 Section "Steel Deck" for field installation of shear connectors.
   3. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
   4. Division 9 Section "Painting" for surface preparation and priming requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
   4. Include design calculations sealed by a professional engineer licensed to practice in the State of Maine for all connections.

D. Certification:
   1. Submit a letter of certification from the material fabricator sealed by a professional engineer licensed to practice in the State of Maine attesting that all shop drawings were prepared under his direct supervision.
   2. Submit certification that field welders are AWS certified.

E. Qualification data for firms and persons specified in the "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.

F. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
   1. Structural steel, including chemical and physical properties.
   2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
   3. Direct-tension indicators.
   4. Shear stud connectors.
   5. Shop primers.
   6. Nonshrink grout.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
   1. Fabricator must hold current membership and be a member in good standing in either AISC or Structural Steel Fabricators of New England (SSFNE).

C. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Code of Standard Practice.
   2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
   3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
   4. AISC's "Seismic Provisions for Structural Steel Buildings."
   5. ASTM A 992/A 992M "Specifications for High-Strength Low-Allow Columbium-Vanadium Structural Steel"
   6. ASTM A 307 "Specifications for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength"
   7. ASTM A 325 "Specifications for Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum"
   8. ASTM A 500 "Specifications for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
   9. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
   10. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

11. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the 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 projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Structural Steel Painting Manual: Comply with applicable provisions of the "Structural Steel Painting Manual.

G. Structural Steel Painting Council: Comply with provisions as follows:
1. SSPC-SP3 - Power Tool Cleaning
2. SSPC-SP6 – Commercial Blast Cleaning

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural steel W-shapes shall conform to ASTM Specification, Serial Designation A 992, as amended to date. Structural steel shapes (other than W-shapes), plates and bars shall conform

to ASTM Specification for Bridges and Buildings, Serial Designation A 36, as amended to date. No secondhand materials shall be used.

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B (Fy = 46 ksi). Hot-Formed Steel

C. Pipe: ASTM A 53, Type E or S, Grade B.

D. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B. All shear studs on this project are ¾' x 2 ½".

E. Anchor Rods, Bolts, Nuts, and Washers: As follows:
1. Unheaded Rods: ASTM A 36.
2. Headed Bolts: ASTM A 307, Grade A; carbon-steel, hex-head bolts; and carbon-steel nuts.
3. Headed Bolts: ASTM A 325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
4. Headed Bolts: ASTM A 490, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
5. Washers: ASTM A 36.

F. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: Plain, uncoated.

G. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Plain, uncoated.
2. Direct-Tension Indicators: ASTM F 959, Type 325.
   a. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC "Specifications for Structural Joints Using ASTM A 325 or ASTM A 490"
      1) Finish: Plain, uncoated.

H. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.
1. Direct-Tension Indicators: ASTM F 959, Type 490, uncoated.
   a. Optional: Snap off tension indicating high-strength bolts certified to provide the minimum fastener tension per AISC "Specifications for Structural Joints Using ASTM A 325 or ASTM A 490"

I. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: All structural steel exposed in the building shall be sandblasted and shop painted with primer paint - Fabricator's Standard Lead – and Chromate-Free, Non-Asphaltic, Rust-inhibiting Primer, except that paint shall conform to AISC specifications and shall be suitable for top coating. (At areas where structural steel is scheduled to receive a finish coat, verify compatibility of primer).

2.3 GROUT

A. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water-reducing and plasticizing agents capable of minimum compression strength of 2,400 lbs. Non-shrink grout shall be "Eucon "N-S" (non-metallic) by the Euclid Chemical Co., "Masterflow 713" (non-metallic) by Master Builders, Five Star Grout by U.S. Grout Corp., or approved equal.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
   1. Camber structural steel members where indicated.
   2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
   3. Mark and match-mark materials for field assembly.
   4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
   5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
   6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.

2.5 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
   2. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed-on fireproofing.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
1. SSPC-SP 3 "Power Tool Cleaning."
2. SSPC-SP 6 "Commercial Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.7 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
4. Ultrasonic Inspection: ASTM E 164.

F. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 WORKMANSHIP - GENERAL

A. Workmanship shall be equal to the best practice in modern structural shops. Material shall be clean and straight. All holes shall be accurately drilled or punched. Burning and drifting to enlarge holes will not be permitted. Holes that must be enlarged shall be reamed. Particular care shall be taken to protect all materials from injury of any kind, either in transportation, storage or erection. Material that is damaged must be replaced by perfect material or repaired in a manner approved and accepted by the Engineer. The use of drift pins will be allowed only to bring together the several parts, and they must not be driven with such force as to distort or injure the material. Material that has been distorted by drift pins will not be accepted.

B. All shop and field welding shall be performed by certified welders in conformance with American Welding Society's "Code for Arc and Gas Welding in Building Construction."

C. No holes shall be burned in steel members under any circumstances without express approval and instructions from the Engineer.

D. Bolted members shall have all parts well pinned-up and firmly drawn together. Abutting joints shall be dressed or cut true and straight and fitted closely together. In compression joints, depending upon contact bearing, the surfaces shall be truly faced so as to have even bearing after they are bolted up complete; and, when properly aligned, the several pieces forming one built-up member shall be straight and shall fit closely together. Finished members shall be free from twists, bends or open joints. Abutting joints in compression members faced for bearing shall be spliced sufficiently to hold the connecting members accurately in place. All other joints in bolted work, whether in tension or compression, shall be fully spliced.

3.3 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.4 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
   a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

H. Protect steel embedded in concrete or gravel with a liberal brushed coat of asphalt mastic.

3.5 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
   1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.6 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
   4. Ultrasonic Inspection: ASTM E 164.

F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:
   1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.7 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
   1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

B. Finish Painting: Finish painting of steel surfaces are included in Division 9 "Painting"

END OF SECTION 05120

SECTION 05210 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Open-web K-series steel joists.
2. KCS-type, open-web K-series steel joists.
3. Joist accessories.

B. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Division 5 Section "Metal Fabrications" for furnishing steel bearing plates.
3. Division 9 Section "Painting" for prime painting.

1.3 DEFINITIONS

A. Special Joists: Joists indicated with suffix "**SP**" and requiring modification by the manufacturer to support nonuniform, unequal, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special "SP" joists and connections capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As specified on structural drawings.

1.5 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
1. Submit a letter of certification from the material fabricator sealed by a professional engineer licensed to practice in the State of Maine attesting that all shop drawings were prepared under his direct supervision.
2. Submit design calculations from the material fabricator sealed by a professional engineer licensed to practice in the State of Maine for all joist types and associated connections.
3. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. 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.

F. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
   1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
   2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer licensed to practice in the State of Maine.
   3. Professional Engineer Qualifications: A professional engineer who is legally authorized 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 joists that are similar to those indicated for this Project in material, design, and extent.

B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

C. Steel Structures Painting Council - SSPC-PS 14.01 - Steel Joist Shop Paint System.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Handle, transport, and store steel joists, steel joist substitutes, at the job site in a manner to prevent permanent distortion of any part or other damages affecting their structural integrity. Replace damaged items that cannot be restored to like-new condition. Store all items off the ground in a well-drained location protected from the weather and easily accessible for inspection and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
   1. Finish: Plain, uncoated.

C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain, uncoated.

D. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.3 OPEN-WEB K-SERIES STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.
   1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

D. Camber joists according to SJI's "Specifications."

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST ACCESSORIES

A. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."

B. Steel bearing plates with integral anchorages are specified in Division 5 Section "Metal Fabrications."

C. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.

D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

A. Clean and prime steel joists, and steel joist substitutes, in accordance with SSPC-PS 14.01, Steel Joist Shop Paint System, except that paint shall conform to SJI specifications and shall be

suitable for top coating. (At areas where steel joists, steel joist substitutes, are scheduled to receive a finish top coating, verify compatibility of primer.)

B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

C. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds [and high-strength bolted connections.

B. Field welds will be visually inspected according to AWS D1.1.

C. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:

1. Radiographic Testing: ASTM E 94 and ASTM E 142.
2. Magnetic Particle Inspection: ASTM E 709.
3. Ultrasonic Testing: ASTM E 164.
4. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.
   1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

E. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
   1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
   2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensure joists and accessories, are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05210

SECTION 05310 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Roof deck.

B. Related Sections include the following:
   1. Division 5 Section "Structural Steel" for shop-welded shear connectors.
   2. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, and deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 PROJECT CONDITIONS

A. Design:

1. Steel deck shall be designed in accordance with the AISI "Specifications for the Design of Cold-Formed Steel Structural Members." Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical.
2. Design Loads: As specified on the drawings.

1.7 COORDINATION

A. Coordinate installation of sound-absorbing insulation strips in topside ribs of 3" acoustical deck with roofing installation specified in Division 7 to ensure protection of insulation strips against damage from effects of weather and other causes.

PART 2 - PRODUCTS

2.1 ROOF DECK

A. Steel Roof Deck (1 ½") – Discovery/Multi-media Space and limited adjacent space, see Roof Framing Plan: Provide galvanized steel roof deck and all necessary accessories conforming to ASTM A611, Grade C, galvanizing conforming to ASTM A525, G60. Steel deck shall be 18-gauge with all required accessories for a complete and finished installation. Accessories to be of the same material as the deck unless otherwise indicated. Metal deck shall be Type B by United Steel Deck, Inc., or approved equal.

2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Adjusting Plates: Provide adjusting plates or segments of roof units in locations too narrow to accommodate full-size roof units. As far as practical, provide plates of the same gauge and configuration as the roof units. Plates of predetermined sizes shall be factory cut.

C. Reinforcing Plates: Provide .057" thick reinforcing plates for all openings less than 12 inches in diameter. Length and width of plates as required satisfying The Steel Deck Institute requirements.

D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

H. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

I. End Closures: Provide end closures of minimum 22 gauge to close the ends at end walls, eaves, and openings through the roof.

J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, thickness as required by manufacturer.

2.3 Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2- inch minimum depth. For drains, cut holes in the field.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate decking bundles to prevent overloading of supporting members.

1. Exercise special care not to damage the material or overload the decking during the entire construction period. The maximum uniform distribution storage load shall not exceed the design live load.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical. Do not use unanchored deck units as a work or storage platform.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking. Reinforce and frame openings through roof in accordance with the drawings for rigidity and load-carrying capacity. Holes or other openings required for the work of other trades shall be drilled or cut and reinforced by the respective trades; the deck manufacturer and the Engineer shall approve such holes or other openings larger than 6 inches in diameter.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 DECK INSTALLATION

A. Immediately after placement and alignment, and after inaccuracies have been corrected, permanently fasten steel roof deck and floor deck units in place. Clamp or weight deck units to provide firm contact between deck units and structural supports while fastening is being performed. Decking shall be fastened as recommended by the manufacturer unless indicated otherwise on the drawings.

B. End Bearing: Install deck ends over supporting frame as per drawings or unless otherwise noted, with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped **2 inches**minimum

C. Roof Sump Pans: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld at each corner.

D. Miscellaneous Roof Deck Accessories: finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

3.4 FIELD QUALITY CONTROL

A. Inspect the decking top surface for flatness after installation. Place a four-foot straightedge across the decking ribs over the structural supporting members at all locations. If the straightedge fails to touch the entire top surface of the decking or if top surfaces of abutting units are not in alignment, corrective measures or replacement shall be provided. After corrective measures or replacement has been performed, the decking shall be reinspected.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does not comply with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. Collect material cutoffs and scrap and place in designated area for recycling, in accordance with the Waste Management Plan.

END OF SECTION 05310

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Steel ladders.
2. Loose bearing and leveling plates.
3. Loose steel lintels.
4. Support angles for elevator door sills.
5. Steel framing and supports for countertops.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Miscellaneous metal trim.
9. Pipe bollards.

B. Related Sections include the following:
1. Division 5 Section "Structural Steel" for structural-steel framing system components.

1.2 SUBMITTALS

A. Product Data: For the following:
1. Paint products.
2. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. 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.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code – Steel".
2. AWS D1.3, "Structural Welding Code – Sheet Steel".
3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.4 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.5 COORDINATION

A. 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, GENERAL

A. Metal Surfaces, General: For metal fabrications 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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Steel Bars for Gratings: ASTM A 36/A 36M.

E. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

F. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

G. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

H. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Carboline 621; Carboline Company.
      b. Catha-Coat 302H; ICI Devoe Coatings.
      c. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
      d. Tneme-Zinc 90-97; Tnemec Company, Inc.

B. Galvanizing Repair Paint: High zinc-dust content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and equal to four (4) times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
   2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).
   3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Hilti Kwik-Bolt Stud Anchors.
      b. Red Head Wedge Anchors.
      c. Rawl Power-Fast Anchors.
      d. Fastenal Stud Anchors.

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

K. Adhesive Anchors: Threaded anchors with a chemical capsule containing prepared amounts of liquid polyester resin, quartz aggregate, and a catalyst. Size and embedment depth shall be as noted on the drawings, or if not noted, as required to withstand required loading. Acceptable products include, but are not limited to:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Hilti HVA Adhesive Anchors.
      b. Red Head Redi-Chem Anchors.
      c. Rawl Needle-Capsule Anchors System.
      d. Fastenal Chemical Capsule Anchors.

L. Sleeve Anchors: Hilti with Hex Nut (HX). Provide tamper-proof nut as indicated.

M. Renovation Anchors: Hilti, HIT C-20 system, female type.

2.5 GROUT

A. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum twenty-eight (28) day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for re-assembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. 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.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120°F (67°C), ambient; 180°F (100°C), material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

B. Fabricate ladders from materials as detailed on the drawings or if not indicated, as follows:
1. Side rails: Continuous, 1/2 by 2-1/2 inch (12 by 64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.
2. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.
3. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
4. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
5. Provide non-slip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

C. Galvanize ladders, including brackets and fasteners, in the following locations:
1. Exterior.
2. Interior, where indicated.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. General: Provide steel framing and supports indicated and as necessary to complete the Work.

C. Fabricate units from structural-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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Fabricate units from slotted channel framing where indicated.
   2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
   3. Furnish inserts if units must be installed after concrete is placed.

D. Galvanize miscellaneous framing and supports where indicated.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:
   1. Exterior.
   2. Interior, where indicated.

2.13 CAST NOSINGS

A. Fabricate units of cast aluminum in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions. Provide units with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or a combination of both.

B. Configurations: Provide units in configurations indicated by model numbers.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Drill for mechanical anchors and countersink. Locate not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

E. Manufacturer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
   1. Wooster Products Inc.: Type 116 with standard anchor.

2.14 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 40 steel pipe.

2.15 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.

2.16 STEEL AND IRON FINISHES

A. 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. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning".

B. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1", for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

C. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Daltagalv by Duncan Galvanizing. The galvanizing bath shall contain high-grade zinc and other earthly materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet-kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. 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.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. 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.

E. 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.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING 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 grout.
1. Use non-shrink, non-metallic grout, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

C. Where bearing plates are indicated with integral anchors, set in cement grout while grout is fluid. Level the surface and provide temporary support while grout hardens. Do not force anchors in partially hardened grout.
1. Where non-shrink grout is indicated, pack between bearing surfaces as indicated above.

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, if any.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.

1. Do not grout baseplates of columns supporting steel girders until girders are installed and leveled.

3.4 INSTALLING NOSINGS

A. Install with anchorage system indicated to comply with manufacturer's written instructions.

B. Center nosings on tread widths.

C. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.5 INSTALLING PIPE BOLLARDS

A. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

B. Fill bollards solidly with concrete, mounding top surface.

3.6 ADJUSTING AND CLEANING

A. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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 (0.05-mm) dry film thickness.

B. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting".

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

SECTION 06105 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Wood blocking and nailers.
2. Wood furring and grounds.
3. Wood sleepers.
4. Plywood backing panels.

B. Related Sections include the following:
1. Division 6 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.
2. Division 7 Section "Thermoplastic Membrane Roofing" for blocking, nailers, cants, sleepers and equipment supports.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. APA: American Plywood Association
2. NeLMA: Northeastern Lumber Manufacturers' Association.
3. NHLA: National Hardwood Lumber Association.
4. NLGA: National Lumber Grades Authority.
5. SPIB: The Southern Pine Inspection Bureau.
6. WCLIB: West Coast Lumber Inspection Bureau.
7. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
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 specified to be High-Temperature (HT) type 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 QUALITY ASSURANCE

A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":
1. Dimension lumber framing.
2. Miscellaneous lumber.
3. Interior wood trim.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. 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.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or 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 equipment support bases and similar members in connection with waterproofing.
2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete on grade or elevated slabs.

2.3 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.
4. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
1. Hem-fir (north); NLGA.
2. Spruce-pine-fir; NLGA.
3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
4. Northern species; NLGA.
5. Eastern softwoods; NeLMA.

C. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Spruce-pine-fir, Select or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Hem-fir or hem-fir (north), Standard or 3 Common grade; NLGA, WCLIB, or WWPA.
2. Spruce-pine-fir, Standard or 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
3. Eastern softwoods, No. 3 Common grade; NELMA.
4. Northern species, No. 3 Common grade; NLGA.

E. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where 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/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

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.

2.6 METAL FRAMING ANCHORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:
   1. Simpson Strong-Tie Co., Inc.
   2. Southeastern Metals Manufacturing Co., Inc.
   3. USP Structural Connectors.

D. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
   1. Use for interior locations where stainless steel is not indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

D. Do not splice structural members between supports, unless otherwise indicated.

E. 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 or lath 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 o.c.

F. Sort and select lumber so that natural characteristics will 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.

G. 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.

H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

I. Use common wire 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; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or 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.

3.3 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. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and/or vertically as indicated at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches on center.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06105

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Wood cabinets.
2. Wood display cabinets with glass doors
3. Plastic-laminate cabinets.
4. Plastic-laminate countertops.
5. Closet and utility shelving.
6. Shop finishing of interior woodwork.
7. Miscellaneous hardware items for Work of this Section.

B. Related Sections include the following:
1. Division 6 Section "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 8 Section " Glass", for glass in display cases
3. Division 10 Section "Visual Display Surfaces" for Tack surface materials required for display cases.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, including and finishing materials and processes.

B. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate cabinet hardware and accessories and finishing materials and processes.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size where necessary to clearly show construction and detail.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for voice/data/power outlets, plumbing fixtures and faucets installed in architectural woodwork.
4. Apply AWI-certified compliance label to first page of Shop Drawings.

D. Samples for Initial Selection:
   1. Shop-applied transparent finishes.
   2. Shop-applied opaque finishes.
   3. Plastic laminates.
   4. PVC edge material.
   5. Thermoset decorative panels.

E. Samples for Verification:
   1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on 1 side and 1 edge.
   2. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
   3. Lumber and panel products with shop-applied opaque finish, 50 sq. in. for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.
   4. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish, with edge banding on 1 edge minimum.
   5. Solid-surfacing materials, 6 inches square.
   6. Corner pieces as follows:
      a. Miter joints for standing trim.
   7. Exposed cabinet hardware and accessories, one unit for each type.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

H. Qualification Data: For Installer if not the fabricator.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products or is a Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 35 and 60 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

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 WOODWORK FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: White maple, plain sawn or sliced.

C. Wood Species for Opaque Finish: Eastern white pine, sugar pine, western white pine or poplar..

D. Wood Products: Comply with the following:
   1. Hardboard: AHA A135.4.
   2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
   3. Particleboard: ANSI A208.1, Grade M-2.
   4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
   5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

E. Panel Edge Materials: Provide the following edge material and finish as appropriate for type of cabinet specified:
   1. Transparent Finished Cabinets: All door and panel edges shall be banded with solid hardwood edges in face width of 3/16 inch (3mm) and shall have corners lapped.
   2. High Density Plastic Laminate (HPDL) Cabinets and Panels: All edges shall receive self-edging, solid color, PVC 3/16 inch (3mm) banding strip system in color matching exposed face. Apply with recommended adhesive in automated banding system.
   3. Melamine Finished Panels (Shelves, etc.): Standard factory applied VGL or PVC self-edging strips."

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
      a. Abet Laminati, Inc.
      b. Arborite; Division of ITW Canada, Inc.
      c. Formica Corporation.
      d. Lamin-Art, Inc.
      e. Nevamar Company, LLC; Decorative Products Div.
      f. Panolam Industries International Incorporated.
      g. Wilsonart International; Div. of Premark International, Inc.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Naming Products)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 to 170 degrees of opening as applicable, self-closing.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1, Grade 2, and Grade 3): For all desk-sized drawers and conventional applications; Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
2. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): For all large Classroom Storage and Workrooms; Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
3. Box Drawer Slides: Grade 1; for drawers not more than 6 inches high and 24 inches wide.
4. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches high or 24 inches wide.
5. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
6. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.

H. Door Locks: BHMA A156.11, E07121. All doors to Teacher's Wardrobe cabinets shall be locking and others as indicated.

I. Drawer Locks: BHMA A156.11, E07041. Provide where indicated.

J. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Product: Subject to compliance with requirements, provide "OG or SG series" by Doug Mockett & Company, Inc. or equal by Outwater Architectural Products.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.
2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

C. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide **Custom-grade** interior woodwork complying with referenced quality standard.

B. 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.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
   2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
   3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Designer seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, 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.
   a. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Division 8 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.6 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: White maple, plain sawn or sliced.
   1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
   2. Matching of Veneer Leaves: Slip match.
   3. Vertical Matching of Veneer Leaves: End match.

D. Semiexposed Surfaces: Provide surface materials indicated below:
   1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
   2. Drawer Sides and Backs: See Hardware above for sides and backs integral with slides as specified where applicable, otherwise, thermoset decorative panels.
   3. Drawer Bottoms: Thermoset decorative panels.

2.7 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade VGS.
   4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

D. Materials for Semiexposed Surfaces:
   1. Surfaces other than Drawer Bodies: Thermoset decorative overlay facing on panels, Grade M-2 melamine.
   2. Drawer Sides: Factory fabricated, epoxy painted metal drawer side-and-slide, European style system equal to Hafele 700 Series, or equal by Grass, Mepla, Zargen and others."
   3. Drawer Bottoms and Backs: Bottom of ¼ inch thick and back of 1/2inch thick thermoset decorative overlay panel product.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Designer from laminate manufacturer's full range in the following categories:
      a. Solid colors, matte finish and/or,
      b. Wood grains, matte finish and/or
      c. Patterns, matte finish.

2.8 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGP.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Designer from manufacturer's full range in the following categories:
      a. Solid colors, matte finish and/or,
      b. Patterns, matte finish.

D. Edge Treatment: Custom, contemporary square edge.

E. Core Material: Particleboard made with exterior glue.

F. Paper Backing: Provide paper backing on underside of countertop substrate.

2.9 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Division 9 painting Sections for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

F. Transparent Finish:
1. Grade: Custom.
2. AWI Finish System: Catalyzed lacquer or Conversion varnish at manufacturer's option.
3. Staining: Match approved sample for color.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets and Display Cases: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips or through metal backing or metal framing behind wall finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to walls with adhesive.
4. Calk space between backsplash and wall and counter with sealant specified in Division 7 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

I. Refer to Division 9 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06402

SECTION 07132 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Butyl rubber sheet waterproofmg/vapor/air barrier system for vertical applications over exterior gypsum sheathing and insulation system, in cavity, behind masonry veneer.

B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water from the exterior and vapor from the interior, through the exterior wall system.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following products or material approved in writing by Designer:
1. Butyl Rubber Sheet:
a. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; CCW-705 vapor/air barrier system.
b. Grace Chemical Company's equivalent to above material.

2.2 SHEET WATERPROOFING

A. Butyl Rubber Sheet: 40-mil-thick flexible sheet, unreinforced, formed from isobutylene-isoprene rubber and containing 4 mil high density polyethylene film and a siliconized release liner.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing and substrate to which membrane is to be applied.

B. Primer: Prime all surfaces of substrates before installation of membrane.
1. Product: CCW-702 primer as manufactured by Carlisle Corporation, Carlisle Coatings & Waterproofing Div. or equivalent recommended by membrane manufacturer.
2. Apply primers with spray, brush or roller at 300 - 350 sq ft per gallon and allow to cure 60 minutes minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
3. Notify Designer in writing of anticipated problems using waterproofing over substrate.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

C. Prepare, fill, prime, and treat joints and cracks in substrate. Remove dust and dirt from joints and cracks according to ASTM D4258.

3.3 FULLY ADHERED SHEET INSTALLATION

A. Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and recommendations in ASTMD5843.

B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.

C. Apply bonding adhesive to substrates at required rate and allow to partially dry.

D. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.4 SEAM INSTALLATION

A. Cement Splice: Clean splice areas, apply splicing cement and in-seam sealant, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to produce a splice not less than 2-1/2 inches and end laps not less than 4-inches wide and to ensure a watertight seam installation.

3.5 PROTECTION AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

END OF SECTION 07132

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Foundation wall insulation (supporting backfill).
   2. Vapor retarders.

B. Related Sections include the following:
   1. Division 4 Section "Unit Masonry Assemblies" for masonry veneered cavity-wall rigid insulation and application thereof over exterior gypsum sheathing and back-up masonry block, on building exterior.
   2. Division 7 Section "Membrane Roofing" for insulation and application thereof over metal roof decking.
   3. Division 9 Section "Gypsum Board and Related Metal Framing" for material and installation in metal-framed assemblies of non-thermal insulation on building interior.
   4. Division 15 Sections "Duct Insulation," "Equipment Insulation," and "Pipe Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: Full-size units for each type of exposed insulation indicated.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products, indicating compliance with performance standards and ratings.

D. Research/Evaluation Reports: For foam-plastic insulation.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source.

B. 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 another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: ASTM E 84.
   2. Fire-Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by 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.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Polyisocyanurate Board Nail-base Insulation Panels:
      a. Atlas Roofing Corporation
      b. Celotex Corporation.
      b. Dow Chemical Company.
      c. Hunter Panels
   2. Extruded-Polystyrene Board Insulation:
      a. DiversiFoam Products.
      b. Dow Chemical Company.
      c. Owens Corning.
      d. Tenneco Building Products.
   3. Glass-Fiber Insulation:
      a. CertainTeed Corporation.
      b. Johns Manville Corporation.
      c. Knauf Fiber Glass.
      d. Owens Corning.

2.2 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: For below-grade applications and elsewhere as specifically indicated; ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
   1. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.

2.3 VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft., with maximum permeance rating of 0.0507 perm.
   1. Available Products:
      a. Raven Industries Inc.; DURA-SKRIM 6WW.
      b. Reef Industries, Inc.; Griffolyn T-65.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

D. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.

2.4 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Board Insulation to Supporting Surfaces: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

C. Board Insulation Joint Tape: Pressure-sensitive tape of type recommended by rigid foam insulation board manufacturer for sealing joints and penetrations, equal to one of the following:
   1. Carlisle Coatings and Waterproofing, Inc.; CCW-705
   2. Polyguard Products, Inc.; Polyguard Tape
   3. Protecto-wrap Company; Protecto Wrap BT20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

B. Close off openings in cavities receiving poured-in-place insulation to prevent escape of insulation. Provide bronze or stainless-steel screens (inside) where openings must be maintained for drainage or ventilation.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

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. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
1. If not indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. Protect top surface of horizontal insulation from damage during concrete work by applying protection board.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to concrete 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.

3.7 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas only where indicated to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indi-

cated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.

C. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor-retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

F. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

END OF SECTION 07210

SECTION 07612 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following on-site, roll-formed sheet metal roofing and siding:
   1. Standing-seam metal roofing at the two major arched entrance canopies.

B. Related Sections include the following:
   1. Division 1 Section "Alternates" for skylights alternate.
   2. Division 5 Section "Structural Steel" for structural-steel framing.
   3. Division 7 Section "Sheet Metal Flashing and Trim" for flashings and other sheet metal work not part of sheet metal roofing and siding.
   4. Division 7 Section "Manufactured Roof Specialties" for fasciae and copings not part of sheet metal roofing or siding.
   5. Division 7 Section "Joint Sealants" for field-applied sheet metal sealants.
   6. Division 8 Section "Translucent Panel Glazed Roof Assemblies"

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide complete sheet metal roofing and wall panel systems, including, but not limited to, on-site, roll-formed metal roof panels, cleats, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal roofing, fascia panels, trim, underlayment, and accessories as indicated and as required for a weathertight installation.

B. Roof Panel Performance:
   1. Wind-Uplift Resistance: Provide portable roll-forming equipment capable of producing sheet metal roofing assemblies that comply with UL 580 for Class 90 wind-uplift resistance.
      a. Maintain UL certification of portable roll-forming equipment for duration of sheet metal roofing and siding work.
   2. Water Infiltration: Provide sheet metal roofing that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal roofing lapped to allow moisture to run over and off the material.

C. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal roofing thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each product indicated. Include details of construction relative to materials, dimensions of individual components and profiles, product specifications, general recommendations as applicable to materials and finishes for each component and total system.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal roofing and siding, including plans, elevations, and keyed references to termination points. Distinguish between shop- and field-assembled work. Include the following:
   1. Details for forming sheet metal panel roofing, including seams and dimensions.
   2. Details for joining and securing sheet metal roofing, including layout of fasteners, clips, and other attachments. Include pattern of seams.
   3. Details of termination points and assemblies, including fixed points.
   4. Details of expansion joints, including showing direction of expansion and contraction.
   5. Details of roof penetrations where applicable.
   6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, sills, caps, and counterflashings.
   7. Details of special conditions.
   8. Details of connections to adjoining Work.
   9. Details of the following accessory items, at a scale of not less than 1-1/2 inches per 12 inches:
      a. Flashing and trim.
      b. Snow guards.

C. Samples for Initial Selection: For each type of sheet metal roofing indicated with factory-applied color finishes, submit manufacturer's standard color selection charts or material chips.
   1. Include similar Samples of trim and accessories involving color selection.

D. Roll-Forming Equipment Certificate: Issued by UL for manufacturer's portable roll-forming equipment designed for producing sheet metal roofing. Show expiration date no earlier than two months after scheduled end of sheet metal roofing.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sheet metal roofing portable roll-forming equipment. Include reports for structural performance.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of sheet metal roofing.

B. Roll-Formed Sheet Metal Roofing Fabricator Qualifications: An authorized representative of roll-formed sheet metal roofing manufacturer for fabrication and installation of units required for this Project.

C. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to sheet metal roofing including, but not limited to, the following:
   1. Meet with Owner, Architect, State Inspector, sheet metal roofing and siding Installer, General Contractor, and installers whose work interfaces with or affects sheet metal roofing including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to sheet metal roofing installation, including portable roll-forming equipment manufacturer's written instructions.
   4. Examine sheathing and purlin and rafter conditions for compliance with requirements, including flatness and attachment to structural members.
   5. Review structural loading limitations of sheathing and purlins & rafters during and after roofing.
   6. Review flashings, special roofing and siding details, roof drainage, penetrations, equipment curbs, and condition of other construction that will affect sheet metal roofing.
   7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
   8. Review temporary protection requirements for sheet metal roofing during and after installation.
   9. Review observation and repair procedures after sheet metal roofing installation.
   10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal coils, components, and other sheet metal roofing materials so as not to be damaged or deformed. Package sheet metal roofing materials for protection during transportation and handling.

B. Unload, store, and erect sheet metal roofing materials in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal coils and sheet metal roofing materials to ensure dryness. Do not store metal coils or sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on sheet metal from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal installation.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and penetrations, which are specified in Division 7 Section "Roof Accessories" and Division 10 Section "Louvers and Vents".

B. Coordinate sheet metal roofing with flashing, trim, and construction of sheathing, purlins and rafters, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing and/or siding that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Installer's Warranty: Roofing Installer's warranty, signed by Roofing Installer, in which Installer agrees to repair or replace components of site-fabricated sheet metal roofing that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Loose parts.
      c. Wrinkling or buckling.
      d. Failure to remain weathertight, including uncontrolled water leakage.
      e. Deterioration of metals, metal finishes, and other materials beyond normal weathering, including nonuniformity of color or finish.
      f. Galvanic action between sheet metal and dissimilar materials.

   2. System Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 ROOFING SHEET METALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
   2. Surface: Smooth, flat finish.
   3. Thickness: 24 gauge (0.025 inch), unless otherwise indicated.
   4. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings (NOTE – Roof Panels applied to base-bid canopies must be factory finished with Organic Finish on <u>both</u> faces);

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1) Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with physical properties and coating performance requirements of AAMA 2605.
   2) Color: As selected by Architect from manufacturer's full range.

b. Factory Prime Coating: For all concealed surfaces, provide pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat; with a minimum dry film thickness of 0.2 mil.

2.3 UNDERLAYMENT MATERIALS

A. General: Apply underlayment as recommended and approved by roofing material manufacturer. At canopies, no underlayment shall be used. "SAPS" shall be applied with 100 percent coverage.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

C. Self-Adhering, Polyethylene-Faced Sheet (SAPS): ASTM D 1970, 40 mils thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.
   1. Available Products:
      a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "A."
      b. Grace, W. R. & Co.; Grace Ice and Water Shield.
      c. Henry Company; Perma-Seal PE.
      d. Owens Corning; WeatherLock.
      e. Polyguard Products, Inc.; Polyguard Deck Guard.

D. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing and siding systems and as recommended by fabricator for sheet metal.

B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
   1. Exposed Fasteners: Heads matching color of sheet metal roofing by means of plastic caps or factory-applied coating.
   2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to produce joints in sheet metal roofing that will remain weathertight and as recommended by roll-formed sheet metal roofing manufacturer for installation indicated.

E. Expansion-Joint Sealant: For hooked-type expansion joints, which must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 ACCESSORIES

A. Sheet Metal Roofing Accessories: Provide components required for complete sheet metal roofing assemblies including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal roofing, unless otherwise indicated.
   1. Roofing System Closures: Provide closures at eaves and ridges, fabricated of same metal as sheet metal roofing.
   2. Clips: Minimum 0.0625-inch- thick, stainless-steel panel clips designed to withstand negative-load requirements.
   3. Cleats: Mechanically seamed cleats formed from the following material:
      a. Metallic-Coated Steel Roofing: 0.0250-inch- thick, stainless-steel or nylon-coated aluminum sheet.
   4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   5. Closures: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match sheet metal roofing profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.0179-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent sheet metal roofing.

2.6 EQUIPMENT

A. Portable Roll-Forming Equipment: Manufacturer's standard UL-certified equipment capable of forming sheet metal roofing in profiles indicated.
   1. Available Manufacturers:
      a. Berridge Manufacturing Company.
      b. Fabral, Inc.
      c. Flexospan Steel Buildings, Inc.
      d. Metal-Fab Manufacturing, LLC.
      e. Morin Corporation; a Metecno Group Company.

2.7 FABRICATION

A. General: Fabricate sheet metal roofing and siding to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the shop to greatest extent possible. Comply with details shown and roll-formed sheet metal manufacturer's written instructions.
   1. Standing-Seam Roofing: Form standing-seam pans with finished seam height of 1-1/2 inches, in the greatest lengths possible to minimize field-formed joints.

B. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.
   1. Lay out sheet metal roofing so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans. Stagger cross seams.
   2. Fold and cleat eaves and transverse seams in the shop.
   3. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leakproof construction.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant (concealed within joints).

D. Sealant Joints: Where movable, nonexpansion-type joints are indicated or required to produce weathertight seams, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

E. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturers of dissimilar metals or by fabricator.

F. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, sheet metal roofing supports, and other conditions affecting performance of work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, studs, furring, and other structural panel support members and anchorages have been installed.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances.
   3. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for roof drains, flashings, vents, and other penetrations through sheet metal roofing and siding.

B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before sheet metal roofing installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate metal roof panels with other rain drainage work; flashing; trim; and construction of soffits, roofing, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
   1. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
   2. Install fasciae and copings to comply with requirements specified in Division 7 Section "Manufactured Roof Specialties."

B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip film from panels with care to avoid damage to finish.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under sheet metal roofing. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures.
   1. Apply over entire roof, in shingle fashion from eave to ridge to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller.
   2. Cover underlayment within 14 days.

B. Install flashings to cover underlayment to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

C. Apply slip sheet over roof underlayment before installing sheet metal roofing if recommended by sheet metal manufacturer.

3.4 INSTALLATION, GENERAL

A. General: Install sheet metal roofing perpendicular to purlins or supports. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing and siding system and as recommended by fabricator of sheet metal.
   1. Field cutting of sheet metal roofing by torch is not permitted.
   2. Rigidly fasten eave end of sheet metal roofing and allow ridge end free movement due to thermal expansion and contraction. Predrill roofing.
   3. Provide metal closures at rake edges, and rake walls of roof system; top and sill caps, jamb closures, etc. for wall system.
   4. Flash and seal sheet metal roofing and siding with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
   5. Locate and space fastenings in uniform vertical and horizontal alignment.
   6. If seams cannot be avoided, locate roofing splices over, but not attached to, structural supports. Stagger roofing splices and end laps to avoid a four-panel lap splice condition.
   7. Lap metal flashing over sheet metal roofing and siding to allow moisture to run over and off the material.

B. Fasteners: Use fasteners of sizes that will not penetrate completely through substrate.
   1. Steel Roofing: Use stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fabricator of sheet metal roofing or manufacturers of dissimilar metals.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Fascia: Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal sheet metal roofing with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 ON-SITE, ROLL-FORMED SHEET METAL ROOFING INSTALLATION

A. General: Install on-site, roll-formed sheet metal roofing to comply with sheet metal roofing manufacturer's written instructions for UL wind-uplift class indicated. Provide sheet metal roofing of full length from eave to ridge unless otherwise restricted by shipping limitations.

B. Standing-Seam Sheet Metal Roofing: Fasten sheet metal roofing to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
   1. Install clips to supports with self-tapping fasteners.
   2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   3. Before panels are joined, apply continuous bead of sealant to top flange of lower panel.
   4. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging field-applied sealant.
   5. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so cleat, sheet metal roofing, and field-applied sealant are completely engaged.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. 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 or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope or wall and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as sheet metal roofing and siding is installed.

B. On completion of sheet metal roofing installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
   1. Clean off excess sealants.

C. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07612

SECTION 07620 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:
   1. Metal flashing.
   2. Reglets.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 4 Sections for through-wall flashing and other integral masonry flashings specified as part of masonry work.
   2. Division 7 Section "Joint Sealants" for elastomeric sealants.
   3. Division 7 Roofing Sections for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
   1. 12-inch-long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

1.5 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Aluminum: 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 of alloy and temper designated below:
   1. Factory-Painted Aluminum Sheet: ASTM B209 , 3003-H14, with a minimum thickness of 0.040 inch , unless otherwise indicated.

B. Galvanized Steel Sheet: ASTM A526, G90 , commercial quality, or ASTM A527, G90 , lock-forming quality, hot-dip galvanized steel sheet with 0.20 percent copper, mill phosphatized where indicated for painting; not less than 0.0396 inch thick, unless otherwise indicated.

C. Lead-Coated Copper: ASTM B101, cold-rolled copper sheet, not less than 20 oz./sq.ft., both sides coated with lead weighing not less than 12 nor more than 15 lb/100 sq. ft., unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

B. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. Drip Edges: Fabricate from the following material:
1. Aluminum: 0.040 inch thick.

B. Equipment Support Flashing: Fabricate from the following material:
1. Galvanized Steel: 0.0276 inch thick.

2.5 ALUMINUM EXTRUSION FABRICATIONS

A. Aluminum Extrusion Units: Fabricate extruded-aluminum running units with formed or extruded-aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

2.6 ALUMINUM FINISHES

A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.

2.7 GALVANIZED STEEL SHEET FINISH

A. High-Performance Organic Coating Finish: Apply the following system by coil-coating process on galvanized steel sheet as recommended by coating manufacturers and applicator.
1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA605.2.
a. Color and Gloss: As selected by Designer from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

E. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
   1. Use joint adhesive for nonmoving joints specified not to be soldered.

F. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
   2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

H. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches and bed with sealant.

I. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07620

SECTION 07710 - MANUFACTURED ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following manufactured roof specialties:
   1. Roof edge flashings, fascia and trim systems.
   2. Counterflashings.

B. Related Sections include the following:
   1. Division 6 Section " Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
   2. Division 7 Section "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
   3. Division 7 Section "Roof Accessories" for manufactured roof accessory units.
   4. Division 7 Section "Joint Sealants" for field-applied sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Manufacture and install manufactured roof specialties to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. FMG Listing: Manufacture and install copings and roof edge flashings that are listed in FMG's "Approval Guide" and approved for Windstorm Classification, Class 1- 75.

C. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:

1. Details for fastening, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
2. Details for expansion and contraction.

C. Samples for Initial Selection: Provide manufacturer's standard color chip set for each type of manufactured roof specialty indicated with factory-applied color finishes.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings and roof edge flashings with performance requirements.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Product Options: Information on Drawings and in Specifications establishes requirements for system's 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.

1.6 COORDINATION

A. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
5. Basis-of-Design Product: The designs for copings, roof edge flashings and counterflashings are based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified.

2.2 EXPOSED METALS

A. Copper Sheet: Where indicate, exposed copper shall comply with ASTM B 370, Temper H00 or H01, cold rolled, mill finished, 16 ounce.

B. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for use and finish indicated, finished as follows:
1. Surface: Smooth, flat finish.
2. Mill finish where concealed from view or applied in a field fabricated system.
3. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.

C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.

D. Prepainted, Zinc-Coated Steel Sheet: ASTM A 653/A 653M, G90 coating designation, structural quality, and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: Smooth, flat finish.
2. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by

weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified below:

1) Humidity Resistance: 1000 hours.
2) Salt-Spray Resistance: 1000 hours.

2.3 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

G. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.

H. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft..

2.5 ROOF PERIMETER TRIM SYSTEM

A. Roof Edge Fascia / "Gravel Stop"/ Trim System: Manufactured, two-piece, roof edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed- or extruded-aluminum anchor bar with integral drip edge cleat to engage

fascia cover and capture membrane roofing. Provide matching mitered and welded corner units. System shall not penetrate the roofing membrane within the potential waterline.

1. Basis-of-Design Product: High performance perimeter finish trim system shall be "Perma-Tite System 500" by Metal Era, Waukesha, WI, or a comparable product by one of the following:
   a. Hickman, W. P. Company.
   b. MM Systems Corporation.
2. Cover: Fabricated from the following exposed metal:
   a. Formed or Extruded Aluminum: 0.050 inch thick.
3. Fascia Cover Color: As selected by Architect from manufacturer's full range.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Fascia Accessories: Fascia extenders with continuous hold-down cleats (if needed), and Overflow scuppers where indicated for water level relief in the event of internal roof drain blockage.

2.6 COUNTERFLASHINGS

A. Available Manufacturers:
   1. Fry Reglet Corporation.
   2. Hickman, W. P. Company.
   3. Metal-Era, Inc.
   4. MM Systems Corporation.

B. Counterflashings: Manufactured units in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal in thickness indicated:
   1. Aluminum: 0.032 inch thick.

C. Accessories: Counterflashing wind-restraint clips.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

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 work.

1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.
   1. Install manufactured roof specialties with provisions for thermal and structural movement.
   2. Torch cutting of manufactured roof specialties is not permitted.

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 manufacturer.
   1. Coat concealed side of uncoated aluminum manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing exposed-to-view components of manufactured roof specialties directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
   3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.

D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet with no unplanned joints within 12 inches of corners or intersections.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

G. Seal joints with elastomeric sealant as required by manufacturer of roofing specialties.

3.3 ROOF EDGE FLASHING INSTALLATION

A. Install cleats, cant dams, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

3.4 COUNTERFLASHING INSTALLATION

A. Counterflashings: Coordinate installation of counterflashings with installation of base flashings. Insert counterflashings in receivers and fit tightly to base flashings. Extend counterflashings 4 inches over base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering. Clean off excess sealants.

B. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07710

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Roof accessories including but not limited to vent stacks.
   2. Preformed flashings.

B. Related Sections include the following:
   1. Division 6 Section "Rough Carpentry" for wood cants, and wood nailers.
   2. Division 7 Section "Metal Roof Panels" for preformed metal roofing.
   3. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, and miscellaneous sheet metal trim and accessories.
   4. Division 7 Section "Manufactured Roof Specialties" for fascia, copings, and gravel stops.
   5. Division 15 Sections for roof curbs to support mechanical equipment and vents.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples: For each type of exposed factory-applied color finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
   1. With Designer's approval, adjust location of roof accessories that would interrupt roof drainage routes.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coated and mill phosphatized for field painting.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.

C. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coated.
   2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coated.
   3. Exposed Finishes: High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in AAMA 2604, except as modified below:
   1) Humidity Resistance: 1000 hours.
   2) Salt-Spray Resistance: 1000 hours.

D. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and finish. Coil-coat finish as follows:
   1. Factory-Prime Coating: Where painting after installation is indicated, provide pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat; with a minimum dry film thickness of 0.2 mil.
   2. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with [**AAMA 2604**] [**AAMA 2605**] and with coating and resin manufacturer's written instructions.
      a. Color and Gloss: As selected by Architect from manufacturer's full range of standard finishes.

E. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Wood Nailers: Softwood lumber, construction grade; not less than 1-1/2 inches thick.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

C. Polyethylene Sheet: 6-mil- thick, polyethylene sheet complying with ASTM D 4397.

D. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
   1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.

2.4 PREFORMED FLASHINGS

A. Vent Stack Flashing: Metal flashing sleeve, with integral deck flange, uninsulated, and as follows:
1. Available Manufacturers:
   a. Thaler Metal Industries Ltd.
   b. Roof system manufacturer
   c. Shop fabricated by roofer.
2. Metal: Lead Coated Copper sheet, 16 oz. or roof membrane manufacturer's recommendation
3. Height: 19 inches.
4. Diameter: As indicated on Drawings and as required for vent pipe size, but not less than 3 inches.

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 work.
1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. 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 manufacturer.
1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Preformed Flashing Installation:
   1. Secure to roof membrane according to vent and stack flashing manufacturer's written instructions.

F. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 07720

SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
   1. Walls and partitions.
   2. Construction enclosing compartmentalized areas.

B. Related Sections include the following:
   1. Division 15 Sections specifying duct and piping penetrations.
   2. Division 16 and 17 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   1. Penetrations located in outside wall cavities.
   2. Penetrations located in construction containing fire-protection-rated openings.
   3. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
   2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
   1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
   2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. 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.

D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
   1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.
      a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
   1) UL in "Fire Resistance Directory."
   2) ITS in "Directory of Listed Products."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturers written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fire Protection Systems, Inc.
   2. Hilti Construction Chemicals, Inc.
   3. Nelson Firestop Products.
   4. RectorSeal Corporation (The).
   5. Specified Technologies Inc.

6. 3M Fire Protection Products.
7. Tremco.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Intumescent Sprays: Sprayable water-based containing elastomeric coating complying with requirements of IBC, ICBO, SBCCI, and NFPA Code #101.

1. Product: Basis-of-Design Products: Subject to compliance with requirements, provide either the named product or comparable products by one of the other manufacturer listed:
   a. 3-M Fire-Dam Spray 100.

H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

J. Silicone Foams: Multi-component, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
   2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
   3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
   1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

Provide firestopping complying with UL assemblies specified below.

Penetration	Assembly	Nelson	Hilti	RectorSeal	STI	3M	Tremco
Metal Pipe	CMU Wall 8" Thick or Less	CAJ1224 or CAJ1203	CAJ1150 or CAJ1158	CAJ1114 or CAJ1115	CAJ1079 or CAJ1217	CAJ1001 or CAJ1009	CAJ1179 or CAJ1187
	Gypsum Board Partition	WL1083 or WL1030	WL1052 or WL1054	WL1026 or WL1034	WL1049 or WL1079	WL1003 or WL1009	WL1020 or WL1051
Non-Metallic Pipe	CMU Wall 8" Thick or Less	CAJ2086	CAJ2095 or CAJ2109	CAJ2021 or WJ2025	CAJ2064 or CAJ2045	CAJ2005	CAJ2082 or FA2024
	Gypsum Board Partition	WL2071	WL2078	WL2015 or WL2104	WL2093 or WL2029	WL2002 or WL2005	WL2083 or WL2082
Cable Tray	CMU Wall 8" Thick or Less	CAJ8049 or CAJ4033	CAJ4017	CAJ8043	CAJ4020 or CAJ4029	CAJ4003 or CBJ4020	CAJ4007 or WJA4005
	Gypsum Board Partition	WL4003	WL4006	N/A	WL4005 or WL4008	WL4004	WL3043 or WL3044
Insulated Metal Pipe	CMU Wall 8" thick or Less	CAJ5008 or CAJ5059	CAJ5045	WJ5016 or CAJ5070	CAJ5021 or CAJ5029	CAJ5001 or CAJ5002	CAJ5052 or CBT5005
	Gypsum Board Partition	WL5036	WL5022 or WL5029	WL5057	WL5014 or WL5051	WL5001	WL5034
Construction Gaps	CMU Wall to Metal Deck	N/A	HW-D-0008	TRC/PV120-14	U900Z020	U900Z028	U900Z013 or U900Z014
	Gypsum Board Partition to Metal Deck	N/A	HW-D-0003 or HW-D-0004	HWD0014 or TRC/PV120-14	HWD1001	U400V	WHPV60.01 or U900Z014

END OF SECTION 07841

SECTION 07920 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

B. This Section includes sealants for the following applications:
   1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:
      a. Control and expansion joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of doors and windows.
   2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      f. Other joints as indicated.

C. Related Sections include the following:
   1. Division 4 Section "Unit Masonry" for masonry control and expansion joint compressible fillers and gaskets.
   2. Division 8 Section "Glazing" for glazing sealants.
   3. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
   4. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 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.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

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. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

E. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

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 PROJECT CONDITIONS

A. Environmental Limitations: 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.
2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
3. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. 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 demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Designer from manufacturer's full range for this characteristic.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.3 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 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 with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and 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 joint-sealant performance.

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, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces 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 surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
      a. Metal.
      b. Glass.
      c. 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 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 of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type 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.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

F. Install sealants by proven techniques to 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 provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 sealants from surfaces adjacent to joint.
   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 configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
   4. Provide flush joint configuration, per Figure 5B in ASTM C1193, where indicated.
   5. Provide recessed joint configuration, per Figure 5C in ASTM C1193, of recess depth and at locations indicated.
      a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
   1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
   2. Apply a bead of silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's printed schedule and covering a bonded area of not less than a 3/8 inch. Hold edge of sealant bead inside of masking tape by 1/4 inch.

3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of horizontal joints before installing vertical joints. Lap vertical joints over horizontal joints. At end of joints, cut silicone extrusion with a razor knife.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants by hand-pull method described below:
   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
   b. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
   c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
4. Inspect tested joints and report on the following:
   a. 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 type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.
   b. Whether sealants filled joint cavities and are free from voids.
   c. Whether sealant dimensions and configurations comply with specified requirements.
5. 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 fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

B. Evaluation of Field-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 sealants 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.7 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Mildew-Resistant Silicone Sealant: Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
   1. Products: Available products include the following:
      a. 786 Mildew Resistant; Dow Corning.
      b. Sanitary 1700; GE Silicones.
      c. 898 Silicone Sanitary Sealant; Pecora Corporation.
      d. Tremsil 600 White; Tremco.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Use Related to Exposure: NT (nontraffic).
   5. Applications: Joints between plumbing fixtures and other materials.

B. Single-Component Nonsag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products: Available products include the following:
      a. Vulkem 116; Mameco International.
      b. Sikaflex - 1a; Sika Corporation.
      c. NP 1; Sonneborn Building Products Div., ChemRex Inc.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Applications: Exterior joints between non-traffic surfaces of all materials.

3.8 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide paintable acrylic latex products complying with the following:
   1. Products: Available products include the following:
      a. AC-20; Pecora Corporation.
      b. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
      c. Tremflex 834; Tremco.
   2. Applications: Interior joints between all non-traffic surfaces.

END OF SECTION 07920

SECTION 08110 – STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Standard hollow metal doors and frames.
2. Exterior insulated metal doors.
3. Fire-rated hollow metal doors and frames.
4. Hollow metal window-walls, glazed openings, and other hollow metal frames for glass.
5. Rough bucks, frame reinforcing, door reinforcing, door insulation, closer reinforcements, clip angles and anchorage.
6. Factory prime paint finish.

B. Related Sections:
1. Division 4 Section "Unit Masonry Assemblies".
2. Division 8 Section "Flush Wood Doors".
3. Division 8 Section "Access Door and Frames".
4. Division 8 Section "Door Hardware".
5. Division 8 Section "Glazing".
6. Division 9 Section "Painting".

1.02 REFERENCES

A. ANSI A250.8-1998/SDI 100 - Recommended Specifications - Standard Steel Doors and Frames, unless herein specified.

B. ANSI A250.4-2001 - Accelerated Physical Endurance Test Procedure for Steel Doors, Frames and Frame Anchors.

C. ANSI A250.10-1998 - Test Procedures and Acceptance Criteria for - Prime Painted Steel Surfaces for Steel Doors and Frames.

D. ANSI A250.11 - Recommended Erection Instructions for Steel Frames.

E. Underwriters Laboratories Inc. UBC 7-2 1997 and UL10c, Positive Pressure Fire Test of Door Assemblies.

F. NFPA-80-1999 - Standard for Fire Doors and Windows.

G. NFPA-101-2000 - Life Safety Code.

H. NFPA-105-1999 - Standard for Smoke and Draft Control Assemblies.

I. ASTM-A1008/A1008M-00 - Specification for Commercial Steel (CS) Sheet, Carbon, Cold-Rolled.

J. ASTM-A568/A568M - Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.

K. ASTM-A653/A653M - Specification for Steel Sheet, Zinc-Coated or Zinc-Iron Alloy-Coated by the Hot Dip Process.

L. SDI-105-92 - Recommended Erection Instructions for Steel Frames.

M. ANSI/BHMA Standards for Builders Hardware A156.

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330. Indicate general construction, configurations, jointing methods, reinforcements, and location of hardware and cutouts for glass and louvers.

B. Door and Frame Schedule: Submit six (6) copies of door and frame schedule in a format recommended by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Door and Frame schedule shall clearly indicate architect's door number, elevations, and notes. The schedule shall be reviewed prior to submission by a Certified Door Consultant (CDC).

C. Product Data: Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, function, design, finish, and options.

D. Samples: Frame Joining Corners and Butt Details, Door Cores and Edge Constructions, and finish sample: Provide 3 samples if requested by Designer.

E. Certification:
1. Submit certification that doors comply with ANSI-A250.4, Level "A", 1,000,000 Cycle Test Criteria and other requirements as listed in these specifications.
2. Submit certification that doors and frames comply with UBC 7-2 1997 and UL10c, Positive Pressure Fire Test of Door Assemblies.

F. Templates: Provide listing of manufacturer's hardware locations for each item of hardware in approved hardware schedule. Furnish other Contractors and Subcontractors concerned with copies of final approved door and frame schedule. Submit necessary templates and schedules as soon as possible to wood door and aluminum door fabricators in accordance with schedule they require for fabrication.

G. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for frames and doors. Send installation instructions to site with first delivery of frames and doors.

H. Closeout Submittals: Comply with Section 01770 including specific requirements indicated.
1. Operating and maintenance manuals: Submit 3 sets containing the following:
   a. Complete information in care, maintenance, and adjustment.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
2. Copy of final approved door and frame schedule, edited to reflect "As installed".
3. Copy of all warrantees; including all appropriate reference numbers for manufacturers to identify the project.

1.04 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of materials (ie. Hollow Metal Frames) from single manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: Recognized commercial hollow metal door and frame supplier and direct distributor of products to be furnished, with warehousing facilities, who has been providing hollow metal doors and frame for period of not less than 3 years. The supplier shall be, or employ, a Certified Door Consultant (CDC) and an Architectural Hardware Consultant (AHC), as certified by the Door and Hardware Institute. The door and frame schedule shall be reviewed and signed by a certified door consultant (CDC).

C. Installer: Firm with 3 years experience in installation of similar hollow metal doors and frames to that required for this project, including specific requirements indicated.

D. Applicable Standards: Specifications and standards of SDF 100-83.

E. Wind Load Performance Requirements: Comply with wind load requirements of Uniform Building Code. Deflection shall not exceed 1/175 of span.

F. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", including compliance with UBC 7-2 1997 and UL10c Positive Pressure Test of Fire Door Assemblies. Assemblies should have been tested, listed, and labeled in accordance with ASTM E152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
   1. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.
   2. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 450 degrees F (232C) or 250 degree F (121 C) maximum in 30 minutes of fire exposure depending upon the local building code.

1.05 PRODUCT HANDLING

A. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage. Deliver doors and frames to the jobsite in a timely manner so as not to delay progress of other trades.

B. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch (101.6) high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide 1/4 inch (6.3) space between doors to promote air circulation.

C. Frame Storage: Store frames under cover on 4 inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4 inch space between frames to promote air circulation.

1.06 GUARANTY/WARRANTY

A. General: Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.
B. Replace shortages and incorrect items with correct material at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function. Manufacturers have been approved only for the category or item listed. Products provided by an approved manufacturer but not listed in the category are not acceptable for use and must receive approval through the prior approval process.

B. Substitutions: Manufacturers and/or products not listed as an acceptable manufacturer and product must submit for approval a physical sample, product description, specifications, catalog cuts, and performance and test data to the Designer 10 working days prior to bid.

C. Manufacturer information:
1. The following is a list of approved manufacturers, address, and website. This information is being supplied for reference only and in no way implies product acceptance. Only the products listed in the respective category are considered to be acceptable for this project.

1)	Ceco	Milan, TN	www.cecodoor.com
2)	Curries	Mason City, IA	www.curries.com
3)	Steelcraft	Cincinnati, OH	www.steelcraft.com
4)	Windsor Republic Doors	McKenzie, TN	www.republicdoor.com

2.02 MATERIALS

A. Fasteners
1. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.

B. Hollow Metal Frames
1. Acceptable Manufacturers:
   a. Curries
   b. Ceco
   c. Steelcraft
   d. Windsor Republic
2. Provide hollow metal frames as scheduled, and drawn and detailed on plans, with the provisions below.
3. Cold Rolled Steel Sheets: Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.

4. Galvanealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvanealed steel sheets for exterior hollow metal door frames. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
5. Minimum gauges of hollow metal frames are specified below. Provide heavier gauge if required by code, details, or specific condition. Entire frame and sidelight shall be of same gauge.
   a. 16 gauge: Interior door, transom, and sidelight frames with nominal door width up to 48".
   b. 14 gauge: Interior door, transom, and sidelight frames with nominal door width over 48".
   c. 16 gauge: Interior window-wall frames and borrowed light frames.
   d. 14 gauge: Exterior frames.
6. Steel Reinforcing: ASTM A36.
7. Door Bumpers or Silencers: Per ANSI A156.16.
8. General: Form to profiles indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.
9. Typical Reinforcing: Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 9 inch and lock strike reinforcement 3/16 inch by 1-1/2 inch by 4 inch long. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and mortised locks. Reinforcing as provided for in ANSI-A250.8.
10. Cover Plates: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.
11. Hardware: Mortise, reinforce, drill and tap for mortise hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.
12. Anchorage: Provide standard and special anchorage items as required. Provide 12 gauge angle clips at bottom of frames with punched holes for securing frames to floor, except where frames are secured entirely by rough bucks. Provide formed steel channel spreader at bottom of frames, removable without damaging frame. At masonry, provide anchors (about 2 inch by 10 inch) approximately 24 inches on center.
13. Silencers: Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and one for each door at double doors.
14. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation. Where required (as at multiple openings) to stabilize large frames, provide frame or mullion extensions to anchor to structure above, proper size to fit within overhead construction. Provide angle clips to fasten to structure.
15. Mullions: Provide mullions, continuously reinforced, straight and without twist, of tubular design. For removable mullions – see Section 08710 "Door Hardware".
16. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16 inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at glass edges. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.
17. Drip Cap: Galvanized steel field painted per Section 09900. Secure to frame at exterior doors.
18. Stops: Set with countersunk or Jackson head screws.
19. Labeled Frames: Construct in accordance with requirements for labeled work. Attach proper U.L. label, Warnok Hersey. "B" labeled frames shall be 1-1/2 hour construction.

20. Joining: At frames with equal width jambs and head, neatly miter on face (except locations as at transom bars and at frames with large head members) and cope and butt stops. At other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly. Weld length of entire frame faces and grind smooth.
21. Workmanship: Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.

C. Hollow Metal Doors and Panels
1. Acceptable Manufacturers and Products:
   a. Curries
   b. Ceco
   c. Steelcraft
   d. Windsor Republic
2. Provide hollow metal doors as scheduled, and drawn and detailed on plans, with the provisions below.
3. Cold Rolled Steel Sheets: Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.
4. Galvanealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvanealed steel sheets for exterior hollow metal doors and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
5. Minimum gauges of hollow metal doors are specified below. Provide heavier gauge if required by specific condition. Doors must comply with 1,000,000 Cycle Test Criteria.
   a. 16 gauge: Interior doors.
   b. 16 gauge: Exterior doors.
6. Steel Reinforcing: ASTM A36.
7. Provide to design indicated including: Flush panel doors, flush panel with cut-out as indicated, stile and rail type, stile and rail with door louver.
8. Flush Doors: Reinforce, stiffen and sound deaden. Provide cut-outs for louvers. Provide standard window molding at interior doors receiving glass. Provide flush steel closure at top and bottom of exterior doors. Provide drain holes in bottom closure. The following door construction types are acceptable.
   a. Exterior Doors: Insulated doors with polyurethane foamed in place in accordance with SDI standards.
   b. Interior Doors: Manufacturer's standard polystyrene, polyurethane foamed in place, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
9. Labeled Doors: Insulate as required by Underwriters Laboratories. Build in special hardware and provide astragals as indicated. At one hour and at 1-1/2 hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in U.B.C. Standard No. 43-2.
10. Seamless Vertical Edges: Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be continuously welded, and ground smooth. At lockset edge of all doors, bevel door edge 1/8 inch in 2 inches of door thickness.
11. Typical Reinforcement: Provide as required for hardware items. For lock reinforcement, provide manufacturer's standard reinforcement. Provide 12 gauge reinforcement for mor-

tise locks, centering clips to hold lock case in alignment. For door checks, provide 3/16 inch channel type reinforcements, 3-1/2 inch deep by 14 inches long. Hinge reinforcement to be a continuous 12 gauge channel with offset depth and screw extrusion equal to minimum 10 gauge or 7 gauge reinforcement plates at hinge mortises, permanently welded to door assembly. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops. Drilling and tapping installation of these surface items shall be done in field by hardware installer.

12. Hardware: Mortise, reinforce, drill and tap for hardware furnished under Section 08710 - Hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field. Obtain templates from hardware supplier.

2.03 FINISHES

A. Frames: Clean frames by degreasing process and apply thorough coating of baked-on primer conforming to ANSI A250.10, covering inside as well as outside surfaces. After welding, grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Coat welds and other disrupted surfaces with zinc-rich paint containing not less than 90 percent zinc dust by weight.

B. Doors: Thoroughly clean off rust, grease and other impurities. Grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Apply thorough coating of manufacturer's standard rust inhibiting primer conforming to ANSI A250.10.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine frames, and related items for conditions that would prevent the proper installation of doors and application of finish hardware. Do not proceed until defects are corrected.

C. Field verify existing frames, doors, finish hardware, and conditions prior to scheduling doors and frames.

3.02 INSTALLATION

A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.

B. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set in accordance with ANSI A250.11. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged. In masonry construction, building-in of anchors and grouting of frames with mortar is specified in Section 04210 - Unit Masonry. At in-place concrete or masonry construction, set frames and se-

cure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.

C. Place fire-rated frames in accordance with NFPA Standard #80.

D. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 3/32 inch, meeting edges pair of doors 1/8 inch, sill where no threshold or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet. Place fire-rated doors with clearances as specified in NFPA Standard #80.

3.03 FIELD QUALITY CONTROL

A. After installation of frames has been completed, a qualified person from the hardware installer is to check the Project to confirm the proper installation of frames to allow for the proper installation of doors and finish hardware scheduled.

B. Installer shall deliver to owner, upon completion, one set of installation and maintenance instructions for doors and frames.

3.04 ADJUSTING AND CLEANING

A. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

3.05 PROTECTION

A. Provide for proper protection of doors and frames until Owner accepts Project as complete.

END OF SECTION 08110

SECTION 08211 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Prefinished standard and fire rated type wood doors with flush faces.
   2. Prefit and premachine pre-finished wood doors.

B. Related Sections:
   1. Section 06105 – Miscellaneous Carpentry.
   2. Section 06402 – Interior Architectural Woodwork.
   3. Section 08110 - Hollow Metal Doors and Frames.
   4. Section 08710 - Door Hardware.
   5. Section 08800 - Glazing.
   6. Section 09900 - Painting.

1.2 REFERENCES

A. WDMA - Window and Door Manufacturers Association: IS 1-A 1997 Industry Standard for Architectural Flush Wood Doors.

B. Underwriters Laboratories Inc. UBC 7-2 and UL10b, Neutral Pressure Fire Test of Door Assemblies.

C. NFPA-80-1999 - Standard for Fire Doors and Windows.

D. NFPA-101-2000 - Life Safety Code.

E. NFPA-105-1999 - Standard for Smoke and Draft Control Assemblies.

F. ANSI/BHMA Standards for Builders Hardware A156.

1.3 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330. Indicate general construction, jointing methods, hardware and louver locations, and locations of cut-outs for glass. Indicate thickness of veneers.

B. Door Schedule: Submit six (6) copies of door schedule in a format recommended by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Door schedule shall clearly indicate architect's door number, elevations, and notes. The schedule shall be reviewed prior to submission by a Certified Door Consultant (CDC).

C. Product Data: Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, description, construction, dimensions, and options.

D. Samples: Submit samples of wood veneer and factory finishing in accordance with WDMA Quality Standards I.S. 1-A 1997, sections G-18 and Guide Specifications 1.03 C.

E. Certification:
   1. Submit certification that doors conform to WDMA I.S. 1-A 1997 requirements and other requirements as listed in these specifications.
   2. Submit certification that doors and frames comply with UBC 7-2 and UL10b, Neutral Pressure Fire Test of Door Assemblies.

F. Furnish Approved Door Schedules to other Contractors and Subcontractors concerned with copies of final approved door schedule.

G. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for doors. Send installation instructions to site with delivery of doors.

H. Closeout Submittals: Comply with Section 01780 including specific requirements indicated.
   1. Operating and maintenance manuals: Submit 3 sets containing the following:
      a. Complete information in care, maintenance, and adjustment.
      b. Catalog pages for each product.
      c. Name, address, and phone number of local representative for each manufacturer.
   2. Copy of final approved door schedule, edited to reflect "As installed".
   3. Copy of all warrantees; including all appropriate reference numbers for manufacturers to identify the project.

1.4 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of materials from single manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: Recognized commercial wood door supplier and direct distributor of products to be furnished, with warehousing facilities, who has been providing hollow metal doors and frame for period of not less than 3 years. The supplier shall be, or employ, a Certified Door Consultant (CDC) and an Architectural Hardware Consultant (AHC), as certified by the Door and Hardware Institute. The door and frame schedule shall be reviewed and signed by a certified door consultant (CDC).

C. Installer: Firm with 3 years experience in installation of similar wood doors to that required for this project, including specific requirements indicated.

D. WDMA I.S. 1-A 1997 Quality Standard: Window and Door Manufacturers Association Quality Standards for grade of door, core, construction, finish, and other requirements.

E. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies in accordance with UBC 7-2 and UL10b, Neutral Pressure Fire Test of Door Assemblies and which are labeled and listed for ratings indicated by ITS - Warnock Hersey, Underwriters' Laboratories or other testing and inspection agency acceptable to authorities having jurisdiction.
   1. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 250 degrees F maximum in 30 minutes of fire exposure.
   2. Doors: Comply with UBC 7-2 and UL10b where required.
   3. Provide smoke gaskets or fire seals as required by manufacturers' individual authorities in compliance with UBC 7-2 and UL-10b.

1.5 PRODUCT HANDLING

A. Deliver wood doors in manufacturer's protective covering. Protect wood doors during transit, storage, and handling to prevent damage, soiling or deterioration. Handle wood doors with care, following the Care and Installation guidelines as described in WDMA I.S. 1-A 1997. Deliver doors to the jobsite in a timely manner so as not to delay progress of other trades.

B. Door Storage: Follow the Care and Installation guidelines as described in WDMA I.S. 1-A 1997. Store doors flat on a level surface in a dry, well-ventilated building. Doors should be kept at least 3-1/2 inches off the floor and should have protective coverings under the bottom door and over the top. Covering should protect doors from dirt, water, and abuse but allow air circulation under and around the stack. Avoid exposure to direct sunlight. Do not subject interior doors to extremes of heat and/or humidity. Prolonged exposure may cause damage. Doors should be stored in Buildings where humidity and temperature are controlled with conditions between 30% to 50% relative humidity and between 50 degrees to 90 degrees Fahrenheit.

1.6 GUARANTY/WARRANTY

A. Provide manufacturer's guarantee for all wood doors for the Lifetime of original installation. Doors exhibiting defects in materials or workmanship including warp and delamination within guarantee period shall be replaced (including hanging and finishing) with new doors. These terms shall be part of the manufacturer's standard warranty.

B. Replace shortages and incorrect items with correct material at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function. Manufacturers have been approved only for the category or item listed. Products provided by an approved manufacturer but not listed in the category are not acceptable for use and must receive approval through the prior approval process.

B. Substitutions: Manufacturers and/or products not listed as an acceptable manufacturer and product must submit for approval a physical sample, product description, specifications, catalog cuts, and performance and test data to the Designer 10 working days prior to bid.

C. Manufacturer information:
   1. The following is a list of approved manufacturers, address, and website. This information is being supplied for reference only and in no way implies product acceptance. Only the products listed in the respective category are considered to be acceptable for this project.
      a. Algoma Hardwoods Algoma, WI, www.algomahardwoods.com
      b. Eggers Industries Two Rivers, WI, www.eggersindustries.com
      c. Lambton Doors, Inc.
      d. Marshfield Door Systems www.marshfielddoors.com
      e. VT Industries Holstein, IA. www.vtindustries.com

2.2 MATERIALS

A. Flush Wood Doors
   1. Acceptable Manufacturers and Products:
      a. Algoma
      b. Eggers
      c. Marshfield Door
      d. VT Industries
      e. Lambton
   2. Provide flush wood doors as scheduled, and drawn and detailed on plans, with the provisions below.

B. Door Construction:
   1. Non-Fire Rated Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to WDMA I.S. 1-A 1997 and the following;
      a. Door construction shall conform to WDMA I.S. 1-A 1997 Premium Grade requirements.
      b. Stiles: Hardwood to match face veneer over structural composite lumber (SCL), glued to core.
      c. Rails: Mill option hardwood or SCL. Top and bottom: 2 inches.
      d. Facing: Wood veneer as specified.
   2. Fire Rated Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to WDMA I.S. 1-A 1997 and the following;
      a. Door construction shall conform to WDMA I.S. 1-A 1997 Premium Grade requirements.
      b. Stiles: Hardwood to match face veneer over mineral composite, glued to core.
      c. Rails: Mineral composite as required by fire door authorities. Top and bottom: as required by manufacturer's fire door authorities.
      d. Facing: Wood veneer as specified.

C. Wood Veneer
   1. Door face veneers shall meet quality standards conforming to WDMA I.S. 1-A 1997 "A" grade for transparent or semi-transparent finish. Minimum face veneer thickness shall be 1/50" at 12% moisture content after finish sanding.
   2. Species: Select White Birch.
   3. Face Cut: Plain Sliced.
   4. Face Assembly: Book Match.
   5. Face Symmetry: Balanced Match.
   6. Plies: 7-ply face sheets.

D. Adhesives
   1. Adhesives: Face to core adhesives shall be Type I throughout and must be classified per WDMA TM-6 "Adhesive Bond Test Method."

E. Core
   1. Non-rated and 20 minute doors: Bonded particle core (PC), type 1-LD-2, conforming to WDMA I.S. 1-A 1997. Provide bonded structural composite lumber, or laminated strand lumber core at doors with full lite, lite over lite, lite/lock conflict, or any door that requires SCLC to maintain lifetime warranty.
   2. Fire-rated doors: Non-combustible bonded mineral core (FD) containing no asbestos conforming to WDMA I.S. 1-A 1997.

2.3 FINISHING

A. Prefinish Wood Doors at factory:
   1. Comply with referenced WDMA Section G-15, "Factory Finishing" for Premium Grade factory finish systems.
   2. Transparent Finish: Match finish indicated in WDMA Section G-17: WDMA System #6. Finish shall be TR-6 stained to uniform, natural, transparent finish. Stain color to be selected by Designer.

2.4 ACCESSORIES

A. Vision Frames:
   1. Non-rated doors: Flush wood frames, hardwood to match facing.
   2. 20 minute fire rated doors: Provide manufacturer's tested metal clip or comparable system with flush wood stop appearance.
   3. Fire-rated doors: Metal low profile kits, ITS - Warnock Hersey or UL approved glazing system.
   4. Glass: Refer to Section 08800 for glass types.

2.5 FABRICATION

A. Fabricate wood doors in accordance with requirements of WDMA I.S. 1-A 1997 Quality Standards.

B. Fabricate fire rated doors in accordance with requirements of ITS - Warnock Hersey or Underwriters' Laboratories, with metal label on each door including UBC 7-2 and UL-10b.

C. Fabricate doors with WDMA Quality Standards hardware blocking options at rated doors as follows:
   1. Provide HB-1 - head and HB-2 - sill rails and HB-4 - lockblock on all doors.
   2. Provide HB-6 only when exit devices are specified for door.
   3. Provide HB-8 for pivots or when floor bolts are specified under Section 08710 - Finish Hardware.

D. Provide doors with minimum ¼ inch thick edge strips, of wood species to match face veneers except as required for fire rating.

E. Make cut-outs and provide stops for glass and louvers. Install metal door louvers. Seal cut-outs prior to installation of moldings.
   1. For full light doors: Provide cut out from flush wood door, with vertical grain direction.

F. Bevel lock and hinge edges of single acting doors 3 degrees or 1/8 inch in 2 inches. Radius strike edge of double acting swing doors as required by pivot hinge manufacturer.

G. Prepare doors to receive hardware. Refer to Section 08710 - Hardware, NFPA 80 1999 and UL-10b Neutral Pressure Fire Door Test Methods.
   1. Prefit and bevel to net opening size less approximately 1/4 inch in width on single swing doors 3/16 inch in width for paired doors. Provide 1/4 inch clearance above finished floor, unless otherwise indicated on drawings. Provide 1/8 inch clearance at top of door.
   2. Slightly ease vertical edges.

H. Fire Rated Pair of Doors; greater than 20 minute: Supply overlapping astragals or metal edge sets only as required by NFPA 80 1999 or by door manufacturer's fire door authorities. If an astragal is required, to comply with fire rated labeling requirements for pairs of fire rated doors, provide door manufacturer's standard tested astragal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installed door frames before hanging doors.

B. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Handle doors in accordance with recommendations of WDMA I.S. 1-A, "Care and Installation at Job Site."

B. Condition doors to average temperature and humidity in area of installation for not less than 48 hours prior to installation. Store doors per recommendations of WDMA I.S. 1-A, "Care and Installation at Job Site."

C. Install in neat and workmanlike manner, free from hammer or tool marks, open joints or slivers.

D. Set plumb, level, square and true. Install work after building humidity is at acceptable level.

E. Remove and replace all doors found to be warped, twisted, bowed, or otherwise damaged. Do not install doors that cannot be properly fitted to frames.

F. Adjust doors and hardware and other moving or operating parts to function smoothly and correctly.

G. Ensure that smoke gaskets are in-place before prefinished door installation.

3.3 FIELD QUALITY CONTROL

A. After installation of frames has been completed, a qualified person from the hardware installer is to check the Project to confirm the proper installation of frames to allow for the proper installation of doors and finish hardware scheduled.

B. Installer shall deliver to owner, upon completion, one set of care and maintenance instructions for doors.

3.4 ADJUSTING AND CLEANING

A. Clean doors and hardware with material and method recommended by manufacturers.

B. Touch-Up: If authorized by Designer in writing, sand and apply touch-up of compatible finish system.

C. Protection Removal: Immediately before final inspection, remove protective wrappings from doors.

D. Repair or replace doors damaged during installation as directed by Designer.

3.5 PROTECTION

A. Provide for proper protection of doors and frames until Owner accepts Project as complete.

B. At finished or unfinished doors, do not partially cover door surfaces with paper, cardboard, or any other opaque covering that will create uneven aging of wood veneer.

END OF SECTION 08211

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wall access doors and frames.
   2. Ceiling access doors and frames.

B. Related Sections include the following:
   1. Division3 Section "Cast-in-Place Concrete" for blocking out openings for access doors and frames in concrete.
   2. Division4 Section "Unit Masonry Assemblies" for anchoring and grouting access door frames set in masonry construction.
   3. Division7 Section "Roof Accessories" for roof hatches.
   4. Division9 Section "Acoustical Panel Ceilings" for access tile in suspended acoustical panel ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

1.4 QUALITY ASSURANCE

A. Fire-Rated Access Doors and Frames: Units complying with NFPA80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. NFPA252 for vertical access doors.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Access Doors:
      a. J. L. Industries, Inc.
      b. Larsen's Manufacturing Company.
      c. Milcor Limited Partnership.
      d. Nystrom Building Products Co.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTMA36/A36M.

B. Hot-Rolled Steel Sheets: ASTMA569/A569M, Commercial Steel (CS), TypeB; free of scale, pitting, and surface defects; pickled and oiled; with minimum thickness indicated representing specified nominal thickness according to ASTMA568/A568M.
C. Cold-Rolled Steel Sheets: ASTMA366/A366M, Commercial Steel (CS), or ASTMA620/A620M, Drawing Steel (DS), TypeB; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTMA568/A568M. Electrolytic zinc-coated steel sheet, complying with ASTMA591/A591M, ClassC coating, may be substituted at fabricator's option.
D. Rolled-Steel Floor Plate: ASTMA786/A786M, rolled from plate complying with ASTMA36/A36M or ASTMA283/A283M, GradeC or D.
E. Aluminum Extrusions: ASTMB221 , alloy6063-T6.
F. Aluminum-Alloy Rolled Tread Plate: ASTMB632/B632M, alloy6061-T6.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FSTT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.4 ACCESS DOORS AND FRAMES

A. Flush, Uninsulated, Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
   1. Locations: Wall surfaces.
   2. Door: Minimum 0.060-inch- thick sheet metal, flush construction.
   3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch-wide, surface-mounted trim.
   4. Hinges: Continuous piano hinge.

2.5 FABRICATION

A. General: Provide access door 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. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
   1. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction.
D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.6 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.

2.7 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. Exteriors (SSPC Zone1B): SSPC-SP6/NACE No.3, "Commercial Blast Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA1, "Paint Application Specification No.1," for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 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.

3.3 ADJUSTING AND CLEANING

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 08311

SECTION 08411 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Exterior entrance systems.
2. Interior entrance systems.
3. Exterior storefront systems.
4. Interior storefront systems.

B. Related sections include the following:
1. Division 7 Section "Joint Sealants" for joint sealants installed as part of aluminum entrance and storefront systems.
2. Division 8 Section "Glazing."
3. Division 8 Section "Aluminum Windows".
4. Division 8 Section "Door Hardware" for hinges, pulls, operators, closers and all associated components to complete entrance system installation except those specified herein.

1.3 SYSTEM DESCRIPTION

A. General: Provide aluminum entrance and storefront systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:
1. Air infiltration and water penetration exceeding specified limits.
2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance. Thermally slotted systems are not acceptable.

D. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E283 at a static-air-pressure difference of 1.57 lbf/sq. ft. .

E. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft. . Water leakage is defined as follows:

1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

F. Average Thermal Conductance: Provide storefront systems with average U-values of not more than 0.63 Btu/sq. ft. x h x degF when tested according to AAMA1503.1.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: For entrance and storefront systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
1. For entrance systems, include hardware schedule and indicate operating hardware types, quantities, and locations.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Sealant Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with sealants; include joint sealant manufacturers' written interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

E. Field Test Reports: Indicate and interpret test results for compliance with storefront systems' performance requirements.

F. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of entrance and storefront systems with requirements based on comprehensive testing of current systems.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Demonstrate to Architect's satisfaction, based on Architect's evaluation of criteria conforming to ASTM E699, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures including, but not limited to, excessive deflection.
2. Adhesive sealant failures.
3. Cohesive sealant failures.
4. Failure of system to meet performance requirements.
5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Failure of operating components to function normally.
7. Water leakage through fixed glazing and frame areas.

C. Warranty Period: 2 years from date of Substantial Completion.

D. Warranty Period for Metal Finishes: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed in these specifications.
1. Kawneer Company, Inc., an Alcoa Company, Norcross, GA www.kawneer.com .
   a. Storefront framing shall be TRIFAB VG451T, thermally broken, capable of accepting multi-plane insulating glazing and panels for exterior system.
   b. Entrances shall be Tuffline 500 Series doors with high bottom rail and Paneline Exit Device operating concealed vertical rods. Framing shall be "standard frame" extrusion thickness in size(s) specified below.
2. Other acceptable manufacturer's whose products, if used in lieu of the above, must exactly match the configuration, style and features of the product specified above, are as follows:
   c. Arch Amarlite.
   d. Butler Manufacturing Company; Vistawall Architectural Products.
   e. International Aluminum Corporation; U.S. Aluminum.
   f. Tubelite Architectural Systems.
   g. YKK AP America, Inc., Austell, GA.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
   1. Sheet and Plate: ASTM B209 .
   2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221 .
   3. Extruded Structural Pipe and Tubes: ASTM B429.
   4. Bars, Rods, and Wire: ASTM B211 .
   5. Welding Rods and Bare Electrodes: AWSA 5.10.

B. Steel Reinforcement: Complying with ASTM A36 for structural shapes, plates, and bars; ASTM A611 for cold-rolled sheet and strip; or ASTM A570 for hot-rolled sheet and strip.

C. Glazing as specified in Division 8 Section "Glazing."

D. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

E. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

F. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

G. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Division 7 Section "Joint Sealants."

H. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.3 COMPONENTS

A. Doors: Provide manufacturer's standard, heavy duty, 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
   1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
   2. Stile Design: Wide stile – 500 Series; 5 inches wide.
   3. Bottom Rail: Optional "High" bottom rail with 10-1/4 inch height.
   4. Exit Device: Paneline panic bar with integral vertical rods where locking or latching. Provide matching fixed "dummy' Paneline panel where no latching rods are required.
      a. Doors requiring Secure latch/locking: Provide integral panic panel and concealed vertical rods equal to Kawneer Paneline with Dor-O-Matic 1900 series vertical lock rods. Paneline bar shall be dogging type with cylindrical lock in panic panel (provided by Door Hardware Section) for secure latch-back of rods/latches.

B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Reinforce members as required to retain fastener threads.
2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153 requirements.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.

F. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
1. Compression Weather Stripping: Molded neoprene complying with ASTMD2000 requirements or molded PVC complying with ASTMD2287 requirements.

G. Framing System Profiles shall be as follows:
1. At Exterior Storefront and all Entrance Systems, provide manufacturer's standard thermally broken extrusions with 2-inch x 4-1/2 inch profile.

2.4 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
1. Fabricate components for screw-spline frame construction.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."

G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by

manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

I. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. 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.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
1. Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluorocarbon topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA605.2.
a. Color and Gloss: As selected by Designer from manufacturer's full range of choices for premium color and gloss, excepting exotics such as metal-flake metallics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Division 7 Section "Joint Sealants."

E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.

F. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
   1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.

G. Install glazing to comply with requirements of Division8 Section "Glazing," unless otherwise indicated.
   1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
   2. Install structural silicone sealant according to sealant manufacturer's written instructions.
   3. Mechanically fasten glazing in place until structural sealant is cured.
   4. Remove excess sealant from component surfaces before sealant has cured.

H. Install secondary-sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.

I. Install perimeter sealant to comply with requirements of Division 7 Section "Joint Sealants," unless otherwise indicated.

J. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
   1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch . Where surfaces meet at corners, limit offset from true alignment to 1/32 inch .
   3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch .

3.3 FIELD QUALITY CONTROL

A. Water Spray Test: After completing the installation of test areas indicated, test storefront system for water penetration according to AAMA501.2 requirements.

B. Repair or remove and replace Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.4 ADJUSTING AND CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.

B. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08411

SECTION 08520 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of aluminum-framed windows:
   1. Factory glazed windows complete with insect screens, reinforcing, shims, anchors, and attachment devices in the following configurations:
      a. Double-hung windows.
      b. Operable top hinged in-swing windows
      c. Fixed windows.

B. Related Sections include the following:
   1. Division 7 Section "Joint Sealants" for backer rod and sealant installation on perimeter joints between window frames and wall materials - interior and exterior.
   2. Division 8 Section "Aluminum Entrances and Storefronts."
   3. Division 8 Section "Glazing" for insulating glass lite requirements and standards for use in factory glazing of window units specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:
   1. Size indicated.

B. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.
   1. Performance Class: AW
   2. Performance Grade: 50

C. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.
   1. Maximum Rate:
      a. Double Hung Windows: 0.3 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq.ft.
      b. Top Hinged Inswing Windows: 0.1 cfm/sq.ft. of area at an inward test pressure of 6.24 lbf/sq.ft..

D. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.
   1. Double Hung Windows and Top Hinged Inswing Windows -Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. or more than 12 lbf/sq.ft.

E. Thermal Movements: Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F , ambient; 180 deg F material surfaces

F. Comply with AAMA/NWWDA 101/I.S.2 for the following tests:
1. Operating Force.
2. Deglazing: When tested according to ASTM E 987.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:
1. Mullion details, including reinforcement and stiffeners.
2. Thermal-break details.
3. Glazing details.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For aluminum window components required, prepared on Samples of size indicated below.
1. Main Framing Member: 12-inch-long, full-size sections of extrusions with factory-applied color finish.
2. Designer reserves the right to require additional samples that show fabrication techniques, workmanship, and design of hardware and accessories.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

B. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Provide AAMA-certified aluminum windows with an attached label indicating compliance with test and performance criteria specified herein.

C. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Failure to meet performance requirements.
   2. Structural failures including excessive deflection.
   3. Water leakage, air infiltration, or condensation.
   4. Faulty operation of movable sash and hardware.
   5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   6. Insulting glass failure.

B. Warranty Period: Three years from date of Substantial Completion.

C. Warranty Period for Metal Finishes: 15 years from date of Substantial Completion.

D. Warranty Period for Glass: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.
   1. Hung and Fixed Windows: Basis of Design is Series 2200, Model 2275H double-hung as manufactured by Graham Architectural Products, York, PA and equivalent Graham Models for single-hung and fixed units.
      a. EFCO Corporation.
      b. Peerless Products, Inc.
      c. TRACO.
      d. Wausau Window and Wall Systems.
      e. YKK AP America, Inc., Austell, GA.
   2. Top Hinged In-swing Windows: Basis of Design is Series 6800, as manufactured by Graham Architectural Products, York, PA .
      a. EFCO Corporation.
      b. Peerless Products, Inc.
      c. TRACO.
      d. Wausau Window and Wall Systems.
      e. YKK AP America, Inc., Austell, GA.

2.2 MATERIALS, GENERAL

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
   1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. Cadmium-plated steel reinforcing members are not permitted.

E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when aluminum window is closed.
   1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/NWWDA 101/I.S.2.

F. Replaceable Weather Seals: Comply with AAMA 701/702.

G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

A. Glass: Clear, insulating-glass with low-E coating complying with Division 8 Section "Glazing."

B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals.

C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

D. Double-Hung Windows: Provide the following operating hardware:
   1. Counterbalancing Mechanism: Comply with AAMA 902.

a. Sash Balance: Concealed tape-spring type of size and capacity to hold sash stationary at any open position.
2. Sash Balances: Two per sash.
3. Handle: Continuous, integral, sash lift bar on bottom rail of forward placed operating sash.
4. Sash Lock: Cam-action sweep lock and keeper on meeting rail; one per sash.

E. Top Hinged Inswing Windows: Provide the following operating hardware:
1. Butt Hinges: two butt hinges with stainless steel pins. Hinges to match the color of the windows of non-rusting and non magnetic materials.
2. Limit Hardware: Use manufacturer's standard limit operating stay arms.
3. Locking Device: Cast in white bronze cam action locks, when vent height exceeds thirty inches provide 2 locking devices. Provide with "Hand" cam lock handles.

2.5 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Locate screens on inside of window and provide for each operable exterior sash or ventilator.
1. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," Residential R-20 class.
2. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.

B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints, concealed fasteners, adjustable rollers, and removable PVC spline/anchor concealing edge of frame.
1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
2. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.040-inch wall thickness.
3. Finish: Match aluminum window members.

C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch- diameter, coated aluminum wire.
1. Wire-Fabric Finish: Natural bright

2.6 FABRICATION

A. General: Fabricate aluminum windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.

B. General: Fabricate aluminum windows, in sizes indicated, that comply with requirements and that meet or exceed AAMA/NWWDA 101/I.S.2 performance requirements for the following window type and performance class. Include a complete system for assembling components and anchoring windows.

C. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

D. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
   1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.

E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

F. Provide water-shed members above side-hinged and top-hinged ventilators and similar lines of natural water penetration.

G. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

H. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

I. Sill Extensions: Provide sill extensions to be supplied with and match the double hung windows. Sill extensions shall extend from under the window out over the top of the masonry sill.

J. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 8 Section "Glazing" and with AAMA/NWWDA 101/I.S.2.

K. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.7 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
      a. Color and Gloss: As selected from full range of custom colors.

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; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances; accurate locations of connections to building electrical system; and other conditions affecting performance of work.
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.

B. 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, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding 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, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.3 ADJUSTING

A. Adjust operating sashes 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.

3.4 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08520

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Commercial Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions, including;
      a. All necessary hardware for installing and securing swinging doors, both fire-rated and nonrated.
      b. Hardware necessary for other doors to the extent indicated.
   2. Electrified door hardware and motorized door operators.
   3. Fasteners and Anchors: Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.

B. Related Sections:
   4. Section 06105 - Miscellaneous Carpentry.
   5. Section 06400 - Architectural Woodwork.
   6. Section 08110 - Hollow Metal Doors and Frames.
   7. Section 08210 - Flush Wood Doors.
   8. Section 08411 - Aluminum-Framed Entrances and Storefronts.
   9. Section 08810 - Glass and Glazing.
   10. Division 16 - Electrical.
   11. Division 17 - Security Access and Surveillance.

1.02 REFERENCES

A. Underwriters Laboratories Inc. UBC 7-2 1997 and UL10c, Positive Pressure Fire Test of Door Assemblies.
B. NFPA-80-1999 - Standard for Fire Doors and Windows.
C. NFPA-101-2003 - Life Safety Code.
D. NFPA-105-1999 - Standard for Smoke and Draft Control Assemblies.
E. The Americans with Disabilities Act (ADA) of 1990 - ADA Accessibility Guide (ADAAG).
F. ANSI 117.1 Accessible and Usable Buildings and Facilities.
G. ANSI/BHMA Standards for Builders Hardware A156.
H. Door and Hardware Institute (DHI) Publications: Sequence and Format for the Hardware Schedule, Abbreviations and Symbols used in Architectural Door and Hardware Schedules and Specifications, Recommended Procedures for Processing Hardware Schedules and Templates, Keying Systems and Nomenclature.

1.03 SUBMITTALS

A. Submit in accordance with Section 01330. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Designer of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.
B. Hardware Schedule: Submit six (6) copies of hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Hardware schedule shall clearly indicate architect's hardware group and manufacturer of each item proposed. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant (AHC).

C. Product Data: Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, function, design, finishes, and options.
D. Samples: Lever design and finish samples: Provide a samples if requested by Designer. Sample may be in the form of a complete, working lockset, which upon approval, may be used in the school.
E. Templates: Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule. Furnish other Contractors and Subcontractors concerned with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to hollow metal, wood door, and aluminum door fabricators in accordance with schedule they require for fabrication.
F. Riser and Wiring Diagrams: Provide complete and detailed system operation and elevation diagrams specially developed for each opening requiring electrified hardware, except openings where only magnetic hold-opens or door position switches are specified. Provide these diagrams with hardware schedule submittal for approval. Provide detailed wiring diagrams with hardware delivery to jobsite.
G. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware.
H. Closeout Submittals: Comply with Section 01780 including specific requirements indicated.
   1. Operating and maintenance manuals: Submit 3 sets containing the following:
      a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
      b. Catalog pages for each product.
      c. Name, address, and phone number of local representative for each manufacturer.
      d. Parts list for each product.
   2. Copy of final approved hardware schedule, edited to reflect "As installed".
   3. Copy of final keying schedule.
   4. As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.
   5. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
   6. Copy of all warrantees; including all appropriate reference numbers for manufacturers to identify the project.

1.04 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of hardware (ie. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.
B. Supplier: Recognized architectural finish hardware supplier and direct distributor of products to be furnished, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be reviewed and signed by a certified AHC.
C. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated.
D. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.
E. Handicapped Requirements: Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

F. Pre-Installation Conference: Prior to the installation of hardware, a jobsite meeting shall be held to review with the installing contractor the installation, scope, details, concerns and condition of in-place Work for the purposes of coordination and confirmation of appropriateness of all existing conditions. Manufacturer's representatives may be asked to attend by the Designer for components of complexity or that incurred difficulty in submittal review. A letter of compliance, indicating when the meeting was held and who was in attendance, shall be sent to the Designer and Owner.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.
B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer. Deliver balance of finish hardware to the jobsite in a timely manner so as not to delay progress of other trades.
C. Storage: The Contractor shall provide a secure and locked room or space for the sole purpose and use of the hardware supplier and installer for the duration of the project.

1.06 GUARANTY/WARRANTY

A. General: Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.
B. Provide five-year factory warranty on exit devices against defects in material and workmanship from date of occupancy of Project.
C. Provide ten-year factory warranty on door closer body against defects in material and workmanship from date of occupancy of Project.
D. Provide a letter or letters from qualified factory representatives of the locksets, closers, and exit devices verifying that their respective products have been properly installed and adjusted.
E. Replace shortages and incorrect items with correct material at no additional cost to Owner.

1.07 MAINTENANCE

A. Maintenance Service Contract: Not Applicable.
B. Extra Materials: The following items shall be delivered directly to the Owner upon completion of the project:
   1. Provide two (1) extra locksets of each function.
   2. Provide three (3) extra closer bodies of each type and two (2) each arm configurations.
   3. All remaining finish hardware fasteners and special tools obtained solely for this project shall be turned over the Owner at the completion of the project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function. Manufacturers have been approved only for the category or item listed. Products provided by an approved manufacturer but not listed in the category are not acceptable for use and must receive approval through the prior approval process.
B. Substitutions: Manufacturers and/or products not listed as an acceptable manufacturer and product must submit for approval a physical working sample, product description, specifications, catalog cuts, and performance and test data to the Designer 10 working days prior to bid.
C. Manufacturer information:

1. The following is a list of approved manufacturers, address, and website (if available). This information is being supplied for reference only and in no way implies product acceptance. Only the products listed in the respective category are considered to be acceptable for this project.

1)	ABH	Elk Grove, IL	www.abhmfg.com
2)	Corbin-Russwin	Monroe, NC	www.yalesecurity.com
3)	Don-jo	Sterling, MA	www.don-jo.com
4)	Dor-o-matic	Harwood Heights, IL	www.doromatic.com
5)	Glynn-Johnson	Indianapolis, IN	www.glynnjohnson.com
6)	Hager	St. Louis, MI	www.hagerhinge.com
7)	Hafele	Archdale, NC	www.hafeleonline.com
7)	Horton	Corpus Cristi, TX	www.hortondoors.com
8)	KM Systems	Monroe, NC	www.kmsystemsinc.com
9)	Key Control	Katy, TX	www.key-control-inc.com
10)	Lund	Bath, OH	www.lundkeycab.com
11)	McKinney	Scranton, PA	www.mckinneyhinge.com
12)	National Guard	Memphis, TN	www.ngpinc.com
13)	Norton	Monroe, NC	www.yalesecurity.com
14)	Pemko	Memphis, TN	www.pemko.com
15)	Precision	Romulus, MI	www.precisionhardware.com
16)	Reese	Rosemont, MN	www.reeseusa.com
17)	Rixson	Monroe, NC	www.yalesecurity.com
18)	Rockwood	Altoona, PA	www.rockwoodmfg.com
19)	Roton	St. Louis, MI	www.hagerhinge.com
20)	Sargent	New Haven, CT	www.sargentlock.com
21)	Schlage	Colorado Springs, CO	www.schlage.com
22)	Stanley	New Britain, CT	www.stanleyworks.com
23)	Telkee	Dover, DE	www.telkee.com
24)	Von Duprin	Indianapolis, IN	www.vonduprin.com
25)	Westguard	Twinsburg, OH	www.westguard-inc.com
26)	Yale	Monroe, NC	www.yalesecurity.com
27)	BEST Access Systems	Indianapolis, IN	www.bestaccess.com

2.02 MATERIALS

A. Screws and Fasteners:
   1. Including, but not limited to, wood or machine screws, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware.
   2. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.
   3. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.
   4. Install all hardware with only fasteners provided or approved in writing by the Manufacturer for use with the specific product and according to the Manufacturers written instructions.

B. Hinges:
   1. Acceptable Manufacturers and Products:

Type	McKinney	Hager	Stanley
Type 1	T4A3795	BB1262	FBB268
Type 2	TA2714	BB1279	FBB179
Type 3	TA2314	BB1191	FBB191
Type 4	T4A3786	BB1168	FBB168
Type 5	T4A3386	BB1199	FBB199

2. Provide hinges where specified in hardware groups for the appropriate application, size, and quantity, unless otherwise noted. Corners shall be square.
3. Application:
   a. Exterior doors over 36 inches wide — Type 5
   b. Exterior doors 36 inches wide or less — Type 3
   c. Interior doors over 36 inches wide — Type 4
   d. Interior doors 36 inches wide or less — Type 2
   e. Interior corridor pairs of doors swinging in same direction (unless reveal or clearance doesn't allow) — Type 1
   f. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
4. Size:
   a. 2-1/4 inch Doors — 5 inches by 5 inches
   b. 1-3/4 inch Doors over 36 inches wide — 5 inches by 4-1/2 inches
   c. 1-3/4 inch Doors 36 inches wide or less — 4-1/2 inches by 4-1/2 inches
   d. 1-3/8 inch Doors — 3-1/2 inches by 3-1/2 inches
   e. Adjust hinge width for door, frame, and/or wall conditions to allow proper degree of opening.
5. Quantity:
   a. Provide 2 hinges per leaf for openings through 60 inches high.
   b. Provide 1 additional hinge per leaf for each additional 30 inches in height or fraction thereof.
6. Drill a 5/32-inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

C. Continuous Hinges:
1. Acceptable Manufacturers and Products:

Type	McKinney	Roton	Pemko
Full Mortise	MCK-12HD	780-112HD	FMSLFHD

2. Provide full mortise type continuous hinges as specified in hardware groups, unless otherwise noted.
3. Provide length appropriate for door type and height.
4. Provide eight (8) adjust-a-screws per hinge to assist in alignment of door in frame.

D. Flush Bolts, Surface Bolts, Dutch Door Bolt, and Dust Proof Strikes:
1. Acceptable Manufacturers and Products:

Type	Rockwood	Hager	Donjo
Manual, Hollow Metal Doors	555	282D	1555
Manual, Wood Doors	555	282D	1555
Automatic, Hollow Metal Doors	1842	292D	FLM-1
Automatic, Wood Doors	1942	291D	FLW-22
Dutch Door Bolt	580-8	276D	1634
Dust Proof Strike	570	280X	1570

2. Non-Labeled Non-Means of Egress Openings: Provide top and bottom manual flush bolts for inactive leaf of non-rated pairs of locked and latched doors where flush bolts are specified in hardware groups, unless noted otherwise. Locate centerline of top bolt not more than 78 inches from finished floor. Provide dust proof strike 570 for bottom bolt.
3. Labeled and/or Means of Egress Openings: Provide automatic flush bolt set as applicable for door type, for inactive leaf of fire rated pairs of doors where flush bolts are specified in hardware groups. Provide dust proof strike 570 for bottom bolt and bar type coordinator.

E. Coordinators:
1. Acceptable Manufacturers and Products:

Rockwood	Hager	Don-jo
1600 Series	297D	2010/2020 Series

2. Provide coordinator where specified in hardware groups and for pairs of doors equipped with automatic flush bolts, with vertical rod/mortise lock exit device combination, and doors equipped with astragal or other hardware that would keep either leaf from latching.
3. Provide filler bars for total opening width, closer mounting brackets, carry bars, and special preparation for top latches where applicable.

F. Locksets – Mortise:
1. Acceptable Manufacturers and Products:

Manufacturer	Series
Sargent	8200 x LNB
Schlage	L9000 x 07A
Corbin-Russwin	ML2000 x CSA
Yale	8700 x MOR
Best	30H x Lever 16

2. Provide mortise lock series and functions where specified in hardware groups, with the provisions below.
   a. Cylinders: Refer to 2.04 KEYING, keying requirements.
   b. Backsets: 2-3/4 inches.
   c. Strikes: Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf. Where required, provide open back strike and protected to allow practical and secure operation.
3. Locksets shall meet ANSI/BHMA A156.13 Operational Grade 1 Series 1000 and Security Grade 1 with all standard trims.
4. Provide locksets properly handed to each opening. Locksets shall be able to be re-handed in the field, if necessary, without opening the lock body.
5. Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

G. Deadlocks:
1. Acceptable Manufacturers and Products:

Manufacturer	Series
Sargent	4870
Schlage	L460
Corbin-Russwin	DL4000
Yale	300

2. Provide mortise deadlock series and functions where specified in hardware groups, with the provisions below.
   a. Cylinders: Refer to 2.04 KEYING, keying requirements.
   b. Backsets: 2-3/4 inches.
   c. Strikes: Provide manufacturers standard wrought brass, bronze, or steel strike.

H. Exit Devices:
1. Acceptable Manufacturers and Products:

Type	Sargent	Von Duprin	Precision	Yale
Touchpad	80 Series	98/35 Series	Apex Series	7100

2. Provide Exit Device series, type, latching/locking functions where specified in hardware groups and as required for opening configuration, frame type, and rating. Sargent product numbers are referenced in the Hardware Groups.
3. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural &

Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

a. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

4. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a tool, or special knowledge for operation.
5. Exit devices for labeled doors shall be UL listed as "Fire Exit Hardware". NFPA 80 distinguishes between panic exit hardware and fire exit hardware. See Evaluations.
6. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. All exit devices shall be UL listed for panic.
7. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
   a. Operation: Rigid.
9. Vertical Rods: Where door and frame configuration does not accommodate rim latching, surface mounted vertical rods shall be provided, compatible with the exit device. All exposed components shall be stainless steel.
   a. Strikes: Stainless steel, low-profile, flat plate strikes for bottom bolts equal to Sargent 647 and standard top strike, 629 or equal.
10. Roller strikes are not acceptable on rim exit devices unless required to meet listing requirements for UL panic. Device must pass a minimum of 1,000 pounds using ANSI A156.3 Static Load Test for testing procedure. Manufacturers written certification required for approval.
11. Guarded latchbolts are not acceptable on mechanical rim exit devices unless required to meet listing requirements for UL "Fire Exit Hardware". Manufacturers written certification required for approval.
12. Provide exit devices factory cut to door width and height. Locate exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, the ADA, and approved by the Designer.
13. Where lever trim is specified, provide lever design to match lockset levers.
14. Provide cylinder-dogging feature for non-rated exit devices.
15. Provide keyed cylinders for all removable mullions, as specified in the Hardware Groups.
16. Provide cylinders for exit devices with locking trim and cylinder dogging.
    a. Cylinders: Refer to 2.04 KEYING, for all keying requirements.

I. Door Trim:

1. Acceptable Manufacturers and Products:

Type	Rockwood	Hager	Donjo
Push Plate	70	30S	71
Pull	BF111	H4J	H20
Pull, offset	BF157	H12J	H1157
Flush Pull	BF94C	H15S	H1848

2. Push Plates: Minimum of 0.050 inches thick and beveled 4 edges.
   a. Provide push plates where specified in hardware groups 4 inches wide by 16 inches high, unless noted otherwise.
   b. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
3. Pull, offset:
   a. Provide offset pull where specified in hardware groups, unless noted otherwise.
   b. Where required, mount back to back with push bar.

4. Flush Pull:
   a. Provide flush pull where specified in hardware groups, unless noted otherwise.
   b. Where required, provide back to back mounted model.
5. Pull:
   a. Provide pull where specified in hardware groups, unless noted otherwise.
   b. Where required, mount back to back with push bar.
6. Pull Plate:
   a. Provide pull x push plate where specified in hardware groups, unless noted otherwise.
   b. Provide plate 4 inches by 16 inches, unless otherwise indicated, and prep for Pull.
   c. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.

J. Door Closers:
1. Acceptable Manufacturers and Products:

Type	Sargent	Norton	LCN
Stop Arm	351-CPS	UNI-7500-BF	4041 Spring Cush
Stop/Holder Arm	351-CPSH	UNI-7500BF-H	4041 Spring Cush Hold-open
Regular Arm	351-O	7500BF	4041 Cush
HD Parallel Arm	351-P10	PR7500BF	4041 Cush 3077 EDA

2. Provide closers for doors where specified in hardware groups and at labeled doors whether or not specifically noted.
3. Provide closers with forged stop arms on all exterior and interior vestibule doors, unless noted otherwise, and for interior doors with a parallel arm mounted closer that swing more than 140 degrees before striking a wall, and for doors that open against equipment, casework, sidelights, and where conditions do not allow a wall stop or a floor stop presents a tripping hazard.
4. Provide closers on interior doors with a forged regular arm or forged heavy duty parallel arm, unless noted or specified otherwise.
5. Provide non-sized closers, adjustable to meet maximum opening force requirements of ANSI 117.1 and ADA (ADAAG).
6. Provide non-handed closers with a minimum plunger diameter of 1-1/2" meeting the requirements of UBC 7-2 and UL 10c Positive Pressure Test of Fire Door Assemblies.
7. Provide closers that incorporate a pressure relief valve or other mechanism in opening and/or closing cycle that will protect the closer and other opening components when excessive force is applied to the door.
8. Provide drop plates, brackets, or adapters for arms as required for details.
9. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless necessary.
10. Provide back-check for closers.
11. Provide forged holder arms where indicated.
12. Provide delayed action where indicated.

K. Automatic Operators:
1. Acceptable Manufacturers and Products:
   a. Horton, 7000LE Series.
   b. Dor-O-Matic, "Senior Swing".
   c. Norton, "Powermatic".
   d. LCN, Auto-equalizer.
2. Provide low energy automatic operator units where specified in hardware groups that are electro-mechanical design.
3. Provide an operator powered with a DC motor working through six reduction gears. Closing shall be spring force or hydraulic The motor is to be off when the door is in closing mode. The

door can be manually operated with the power on or off without damage to the operator. Provide power on/off switch for manual operation. The operator shall include variable adjustments, including opening and closing speed adjustment, to enable it to comply with ANSI A156.19. Operator shall be mounted in an aluminum cover.

4. Provide drop plates, brackets, or adapters for arms as required for details.
5. Provide wall-mounted actuator switches for operation. Actuators shall be weather-resistant type at exterior applications. Provide key switches with LED's and cylinder as required to activate and shunt the system for lockdown or security reasons. Field verify locations of actuators and key switches with the Designer.
6. Where Auto Door Controls are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material for each individual leaf. Switches shall control both doors simultaneously at pairs of doors. All wiring, including connection to electrical power, fire alarms, and/or smoke evacuation system, is by others.

L. Overhead Stops and Overhead Stop/Holders:
1. Acceptable Manufacturers and Products:

Type	Sargent	ABH	Glynn Johnson
Surface, Med.-Duty	1540 Series	3300 Series	450 Series

2. Provide overhead stop or overhead stop/holder where specified in the hardware groups, unless otherwise noted.
3. Provide medium duty surface overhead stop for doors with a regular arm mounted closer or without a closer that swing more than 140 degrees before striking a wall, and for doors that open against equipment, casework, sidelights, and where conditions do not allow a wall stop or a floor stop presents a tripping hazard.
4. Provide stop arms for doors with a parallel arm mounted closer that swing more than 140 degrees before striking a wall, and for doors that open against equipment, casework, sidelights, and where conditions do not allow a wall stop or a floor stop presents a tripping hazard.
5. Where overhead holders are specified provide friction type at doors without a closer and positive type at doors with a closer.
6. Provide sex bolt attachments on overhead stops only.

M. Stops and Holders:
1. Acceptable Manufacturers and Products:

Type	Rockwood	Hager	Donjo
Wall, convex	406	232W	1406
Floor	440/442	241F/243F	1440/1442
Holder	461L	271F	1465

2. Provide a wall stop for each door leaf where specified in hardware groups, unless floor stops are noted.
3. Floor stops shall be used only where definitely specified or absolutely unavoidable.
4. Provide appropriate fasteners for details and wall construction indicated.
5. Provide holders where specified.

N. Protection Plates and Edge Guards:
1. Acceptable Manufacturers and Products:

Type	Rockwood	Hager	Donjo
Protection Plates	K1050 B4E	194S	90 B4E

2. Protection Plates: Provide mop plates, kick plates and armor plates minimum of .050 inches thick and beveled 4 edges where specified in hardware groups, unless noted otherwise.
   a. Provide width two inches less than door width on stop side and one inch less than door width on face side at single doors unless door, frame, or edge guard details prevent then adjust size to fit.
   b. Provide width one inch less than door width on either side at pair doors unless door, frame, or edge guard details prevent then adjust size to fit.

c. Provide heights below unless door or frame detail prevents then adjust size to fit.
   1) Kick Plates: 10 inches, unless noted otherwise.
      a) Coordinate with door bottom-rail at aluminum entrances. Kick plates shall be 6" high on aluminum doors or sized as necessary to provide equal ½" margins of exposed aluminum door face around perimeter.
   2) Armor Plates: 34 inches, unless noted otherwise.

O. Removable Mullions:
1. Provide removable mullions, straight and without twist, of tubular design, compliant with BHMA A156.3, equal to Sargent 12-L980, prime painted for field finishing to match adjacent frames.
2. Provide fastenings of non-ferrous bolts at bottom, with sleeves at head of frame for mullion to clip over and be secured by cylinder lockset provided in another Section of these Specifications.
3. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

P. Thresholds:
1. Acceptable Manufacturers and Products:

Pemko	Reese	National Guard	Hager
171	S205	425	4125

2. Provide thresholds where specified in hardware groups, unless detailed or otherwise noted.
   a. Refer to drawings for special details. Provide accessories, shims and fasteners.
   b. Where thresholds occur at openings with one or more mullions, they shall be cut for the mullions and extended continuously for the entire opening.

Q. Weatherstripping:
1. Acceptable Manufacturers and Products:

Type	Pemko	Reese	National Guard	Hager
Weatherstripping	316V	DS75	152	890S
Astragals	18061P	964C	C607	802S
Sweeps	315N	323	200N	750SS
Rain Drip	346	R201	16A	810S

2. Provide weatherstripping at jambs and heads where specified in hardware groups, unless detailed or noted otherwise.
   A. Provide self-tapping fasteners for weatherstripping being applied to hollow metal frames.
3. Provide 2 pieces of astragals as specified in hardware groups, unless detailed or noted otherwise.
4. Provide sweeps as specified in hardware groups, unless detailed or noted otherwise.
5. Provide rain drips as specified in hardware groups by full frame width, unless detailed otherwise.

R. Smoke Gasketing:
1. Acceptable Manufacturers and Products:

Type	Pemko	Reese	National Guard	Hager
Gasket	PK55D	F-897B	2525	736

2. Where smoke gasketing is specified in hardware groups provide gasket unless detailed or noted otherwise.
3. Provide gaskets for 20-minute doors and doors designated for smoke and draft control.
4. Where frame applied intumescent seals are required by the manufacturer, provide gaskets that comply with UBC 7-2 and UL 10C positive pressure tests.
5. Provide accessories, shims and fasteners.

S. Sound Gasketing:
1. Acceptable Manufacturers and Products:

Type	Pemko	Reese	National Guard	Hager
Gasket	350SR	99	105N	865S
Threshold	2005T	S483	896S	520S
Automatic Door Bottoms	434ARL	430	422N	743S

2. Where sound gasketing is specified in hardware groups provide gasket, threshold, and automatic door bottom unless detailed or scheduled otherwise.
   a. Provide self-tapping fasteners for all gasketing assemblies being applied to hollow metal doors and frames.
   b. Cutting or notching of sound gasket for stop mounted hardware shall not be permitted.

T. Door Silencers:
1. Acceptable Manufacturers and Products:

Type	Westguard	Hager	Donjo
Hollow Metal Frame	650ST	307D	1608
Wood Frame	640WD	308D	1609

2. Provide door silencers for the appropriate frame type where specified in hardware groups, and where weatherstripping or gasketing is not being used.

U. Magnetic Holders:
1. Acceptable Manufacturers and Products:

Type	Sargent	ABH	Rixson
Wall	1504	2100/2200	990/998
Floor	1517	2720	981

2. Provide 24 VAC wall or floor mounted magnetic holders where specified in the hardware groups, unless detailed or noted otherwise.
3. Provide appropriate brackets, extensions, and fasteners for details.

2.03 FINISHES AND MATERIALS

A. Finishes, unless otherwise specified:
1. Pivots and hinges on exterior doors:
   a. US32D (BHMA 630) Satin Stainless Steel on Stainless Steel.
2. Hinges: Interior Doors
   a. US26D (BHMA 652) Satin Chromium on Steel.
3. Continuous Hinges:
   a. Clear Anodized Aluminum.
4. Flush Bolts:
   a. US26D (BHMA 626) Satin Chromium on Brass or Bronze.
5. Exit Devices:
   a. US32D (BHMA 630) Satin Stainless Steel on Stainless Steel.
6. Locks and Latches:
   a. US26D (BHMA 626) Satin Chromium on Brass or Bronze.
7. Door Trim:
   a. US32D (BHMA 630) Satin Stainless Steel on Stainless Steel.
8. Coordinators:
   a. USP (BHMA 600) Primed on Steel.
9. Protection Plates:
   a. US32D (BHMA 630) Satin Stainless Steel on Stainless Steel.
10. Overhead Stops and Holders:
   a. US26D (BHMA 626) Satin Chromium on Brass or Bronze.
11. Closers: Surface mounted
   a. Sprayed Lacquer to Match.

12. Wall Stops:
    a. US32D (BHMA 630) Satin Stainless Steel on Stainless Steel.
13. Floor Stops:
    a. US26D (BHMA 626) Satin Chromium on Brass or Bronze.
14. Thresholds and Weatherstipping:
    a. Mill Finish Aluminum.
15. Miscellaneous Hardware:
    a. US26D (BHMA 626) Satin Chromium on Brass or Bronze.

2.04 KEYING

A. Acceptable Manufacturers and Products:
    1. Sargent (ONLY).
B. Provide manufacturer's standard removable core cylinders with a Restricted or "Signature Series" Keyway with limited utilization within appropriate geographical radius. Provide construction core cylinders, for use during construction. The construction keying will be voided by use of the permanent change key upon completion of the building or by replacement with the permanent, final keyed, cylinder cores.
    1. Provide keyed, removable core cylinders for all removable mullions, locksets, deadlocks, panic device dogging cylinders, etc. as specified in the Hardware Groups.
C. Factory key all cylinders with manufacturer retaining permanent keying records. Provide Owner with copy of bitting list via registered mail.
D. Submit proposed keying schedule to Designer. Meet with Owner and Designer to review keying schedule and lock functions prior to ordering finish hardware.
E. All cylinders, unless noted otherwise, shall be operated by Grand Master Key System to be coordinated with the existing building and Department-wide system. Allow for twenty-five (25) Master Keys under each Grand Master, and One-Hundred Fifty (150) changes under each master key. All cylinders shall be keyed in alike or different sets as noted by their respective key set number (Do not use the letter "I" in any of the master key sets).
F. Provide key quantities as follows:
    1. Ten (10) Grand Master Keys
    2. Ten (10) Master Keys (each set)
    3. Three (3) Change Keys (each cylinder)
    4. Six (6) Construction Master Keys (Contractor is to provide one key to Designer)
G. Visual key control:
    1. All keys shall be stamped with their respective key set number and stamped "DO NOT DUPLICATE".
    2. Grand master and master keys shall be stamped with their respective key set letters.
    3. Do not stamp any keys with the factory key change number.
    4. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.
H. All change keys, key blanks, master, and grandmaster keys shall be shipped directly from the factory to the Owner via registered mail, confidential, or delivered directly to the Owner by the hardware supplier in sealed containers, who shall obtain a receipt for delivery of same. All change, master, grandmaster, and great grandmaster keys must be delivered in tamperproof packaging. Tamperproof packaging shall mean boxes of keys shall be shrink wrapped, with material identified with imprinting reading "SEALED FOR YOUR SECURITY", by the manufacturer or local hardware supplier's key shop.

2.05 KEY CONTROL

A. Key Cabinet
    1. Acceptable Manufacturers:

a. Telkee
b. Lund
c. Key Control

2. Provide one (1) key cabinet.
3. Provide cabinet with one hook for each lock or cylinder plus at least 150 percent extra hooks, necessary to accommodate the keys from the existing building which shall also be housed in this system.
4. Provide each hook with one non-removable security key tag and one snap-on link duplicate key tag.
5. Provide tools, instruction sheets and accessories required to complete and maintain the installation thereafter.
6. Hardware supplier will place keys in key cabinet and complete index cards furnished with key system. Provide electronic file of key index to Owner on a disc in MS Excel format.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.
B. Field verify existing doors, frames, hardware, and conditions prior to scheduling hardware.

3.02 INSTALLATION

A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied, remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.
B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.
C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.
D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).

3.03 FIELD QUALITY CONTROL

A. After installation has been completed, a qualified person from the hardware supplier is to check the Project to determine proper application of finish hardware according to schedule.
B. At completion of project, a qualified factory representative for the Manufacturers of locksets, closers, and exit devices shall inspect installations of their products. After the inspections a letter shall be sent to the Designer reporting on conditions, verifying that their respective products have been properly installed and adjusted.
C. Installer shall deliver to Owner, upon completion, one set of installation and maintenance instructions and specialty tools for all hardware items.

3.04 ADJUSTING AND CLEANING

A. At completion, hardware shall be left clean and free from disfigurement. Make adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.
B. Adjust door closers to meet opening force requirements of ADA Accessibility Standards.
C. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make/ check adjustments of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.
E. Final Adjustment: Installer shall return six months after substantial completion to make final adjustments of all hardware items.
F. Installer shall instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.
G. Clean adjacent surfaces soiled by hardware installation.

3.05 PROTECTION

A. Provide for proper protection of items of hardware and building security until Owner accepts Project as Substantially Complete.

PART 4 - HARDWARE SCHEDULE

4.01 HARDWARE GROUPS AND SUFFIXES

A. The following schedule of hardware groups shall be considered a guide only, and the supplier is cautioned to refer to general conditions, special conditions, field conditions, and the preamble to this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. Refer to the door schedule for special hardware notes, applications, and/or requirements.

C. Italicized text indicates hardware specified here for clarity but specified to be provided as part of the manufactured aluminum entrances system(s) in another Division 8 Section.

GROUP 1 Single with rim exit device
Continuous Hinge as specified
1 each Latchset Passage Function
Function: Latchbolt retracted by lever either side at all times.
1 each Closer
1 each Kick Plate
1 each Threshold
1 each Sweep
1 set Weatherstripping
1 each Rain Drip

GROUP 2 Pair with vertical rod exit devices and Automatic Operator (Exterior Aluminum)
Continuous Hinges as specified
1 each Integral Exit Device and concealed vertical rods by Door Mfr.
Function: Outside access by pull when device is dogged. Egress by inside touchpad. Manual dogging of exit device only by key.
1 each Integral Exit Device and concealed vertical rods by Door Mfr. prepared for lock Cylinder specified below.
Function: Key outside retracts vertical rod bolts. Outside access by pull or activation by power operator push-button (or remote) when device is dogged. Manual dogging of exit device only by key.
2 each Door pulls – offset type.By Door Mfr.
1 each Automatic Operator (Mounted on door equipped with lock cyl. above)
1 each Power Supply
2 each Actuators

1 each Key Switch x Cylinder
3 each Cylinders for exit device dogging (2), and entry access at one leaf with prep. (1)
1 each Closer
1 each Overhead Stop
2 each Kick Plate
1 each Threshold
2 each Sweep
1 set Weatherstripping

All wiring and connections by Division 16.
Operational Description: Immediate egress always allowed. Door is normally closed and latched. Access manually, as described above in function of exit device, or by depressing actuator, when exit device is manually dogged, to automatically open door. Exit device must be manually dogged prior to activating automatic operator. Actuator or remote sends a low voltage or wireless signal to automatic operator to open. Key switch shall shut down automatic operator. Locate actuators and key switch as directed by Designer.

GROUP 3 Pair with vertical rod exit devices and Automatic Operator (Interior Aluminum)
Continuous Hinges as specified
1 each Integral Exit Device and concealed vertical rods by Door Mfr.
Function: Outside access by pull when device is dogged. Egress by inside touchpad. Manual dogging of exit device only by key.
1 each Integral Exit Device and concealed vertical rods by Door Mfr. prepared for lock Cylinder specified below.
Function: Key outside retracts vertical rod bolts. Outside access by pull or activation by power operator push-button (or remote) when device is dogged.
Manual dogging of exit devices only by key.
2 each Door pulls – offset type by Door Mfr.
1 each Automatic Operator (Mounted on door equipped with lock cyl. above)
1 each Power Supply
2 each Actuators
1 each Key Switch x Cylinder
3 each Cylinders for exit device dogging (2), and entry access at one leaf with prep. (1)
1 each Closer
1 each Overhead Stop
2 each Kick Plate
1 each Threshold

All wiring and connections by Division 16.
Operational Description: Immediate egress always allowed. Door is normally closed and latched. Access manually, as described above in function of exit device, or by depressing actuator, when exit device is manually dogged, to automatically open door. Exit device must be manually dogged prior to activating automatic operator. Actuator or remote sends a low voltage or wireless signal to automatic operator to open. Key switch shall shut down automatic operator. Locate actuators and key switch as directed by Designer.

GROUP 3A Pair with dummy, integral exit devices and Automatic Operator (Interior Aluminum)
ALL hardware noted above but WITHOUT lock cylinders for dogging and entry.

GROUP 4 Pair with rim exit devices and Automatic Operator (Interior Aluminum)
Continuous Hinges as specified (Electric at leaf nearest Office)

1 each Exit Device 16-8810
Function: Outside access by pull when device is dogged. Egress by inside touchpad.
1 each Exit Device (Electric) 56-16-8804
Function: Key outside retracts latchbolt. Outside access by pull when device is dogged. Remote Pushbutton release system (Div. 16) initiates power actuated latch retract (Fail Secure) for entry authorized from Office. Manual dogging of exit device by key only.
2 each *Door pulls – offset type. By Door Mfr.*
1 each Power Supply
1 each Pushbutton exit device latch- retract actuator
3 each Cylinders for exit device dogging (2), and entry access at one leaf with prep. (1)
1 each Cylinder for removable mullion
1 each Removable Mullion 12-L980
1 each Closer
1 each Overhead Stop
2 each Kick Plate
1 each Threshold
2 each Sweep
1 set Weatherstripping

All wiring and connections by Division 16.
Operational Description: Immediate egress always allowed. Door is normally closed and latched. Access manually, as described above in function of exit device. Pushbutton release sends a low voltage signal to electric latch retract feature of single exit device to permit entry when authorized. Locate pushbutton in Office area where directed by Designer and Owner.

GROUP 5 Pair with flushbolts and deadbolt
Hinges as specified
1 pair Flushbolts
1 each Dust-Proof Strike
1 each Deadlock Storeroom Function (4876)
Function: Bolt operated by key at exterior. No interior trim
2 each Silencers
2 each Flush pull
2 each Overhead Stop/Holder
Note: Mount deadlock on active leaf.

GROUP 6 Single
Hinges as specified
1 each Lockset Classroom Function
Function: Latchbolt retracted by lever either side unless outside lever is locked by key. Key outside locks or unlocks outside lever. Deadlocking latchbolt.
1 each Stop
3 each Silencers
1 each Kickplate

GROUP 7 Pair with rim exit devices - Rated
Continuous Hinges as specified
2 each Exit Devices 8863 x less dogging
Function: Exterior entry by key and pull with thumbpiece trim. Key locks and unlocks thumbpiece. Egress by inside touchpad.
2 each Exit device trim 896STS

2 each Cylinders for trim
1 each Cylinder for removable mullion
1 each Removable Mullion 12-L980
2 each Closers
2 each Kick Plates
1 each Threshold

GROUP 8 Pair with vertical rod exit devices (Interior Aluminum)
Continuous Hinges as specified
2 each Integral Exit Device and concealed vertical rods by Door Mfr.
Function: Outside access by pull when device is dogged. Egress by inside touchpad. Manual dogging of exit device only by key.
Manual dogging of exit devices only by key
2 each Door pulls - Offset type by door Mfr.
2 each Cylinders for dogging
2 each Closers
1 each Threshold
2 each Kickplates
2 each Sweeps
2 sets Weatherstripping

GROUP 9 - Single
Hinges as specified
1 each Lockset Storeroom Function
Function: Latchbolt retracted by both levers. Key on either side projects deadbolt. Levers will not retract deadbolt from either side.
1 each Stop
3 each Silencers

GROUP 10 Single with closer
Hinges as specified
1 each Lockset (Dorm) Privacy Function with Emergency Outside Turn Rose & Indicator
Function: Latchbolt retracted by lever either side unless turn piece inside locks outside lever. Turn-piece released by turning inside lever or by closing door. Deadlocking latchbolt. When deadbolt is projected indicator button changes color or other means of identification indicating room is occupied. Emergency turn rose on outside unlocks outside lever.
1 each Closer
1 each Kick Plate
1 each Stop
1 set Sound Gasketing
1 each Door bottom

GROUP 11 Single
Hinges as specified
1 each Lockset Office Function
Function: Latchbolt retracted by lever either side unless outside lever is locked by toggle on lock front (mortise). Key outside retracts latchbolt. Deadlocking latchbolt.
1 each Stop
1 each Kickplate
1 set Sound Gasketing

GROUP 12 Single
Hinges as specified
1 each Lockset Classroom (38) Security Function
Function: Latchbolt retracted by lever either side unless outside lever is locked by key. Key outside or inside locks or unlocks outside lever. Deadlocking latchbolt. Inside trim always operative, but outside lever if locked remains locked.
1 each Stop
1 each Kickplate
1 set Sound Gasketing
1 each Door Bottom

GROUP 13 Single
Hinges as specified
1 each Latchset Passage Function
Function: Latchbolt retracted by lever either side at all times.
3 each Silencers
1 each Stop

GROUP 14 Single with closer
Hinges as specified
1 each Lockset Privacy Function with Outside Turn Rose
Function: Latchbolt retracted by lever either side unless push button or turn piece inside locks outside lever. Turn-piece released by turning inside lever or by closing door. Emergency turn rose on outside unlocks outside lever.
1 each Closer
1 each Stop
1 set Sound Gasketing

GROUP 15 Single with closer
Hinges as specified
1 each Lockset Office Function
Function: Latchbolt retracted by lever either side unless outside lever is locked by turn button on inside (cylindrical) or toggle on lock front (mortise). Key outside retracts latchbolt. Deadlocking latchbolt.
1 each Closer
1 each Stop
3 each Silencers
1 each Kickplate

GROUP 16 Rated Pair with Automatic flushbolts
Hinges as specified
1 each Lockset Storeroom Function
Function: Latchbolt retracted by lever inside only. Outside lever is always rigid. Key outside retracts latchbolt. Deadlocking latchbolt.
1 pair Labeled Automatic Flushbolts
1 each Strike
2 each Closers with hold-open arms
2 each Armor Plates
1 set Labeled Astragal
1 set Coordinator

GROUP 17 Non-Rated Pair with surface vertical rod exit devices
Hinges as specified
1 each Exit Device 8710 x ET
Function: Outside access by dummy lever when device is dogged. Egress by inside touchpad.
1 each Exit Device 8713 x ET
Function: Key outside locks or unlocks outside lever. Outside lever retracts bolts unless lever is locked, or can pull door open when devices are dogged. Egress by inside touchpad.
2 each Closers with 100 deg. arms
1 set Soundgasketing
2 each Kick Plates
2 each Door Holders
2 each Silencers

GROUP 18 Rated Pair with Double Egress Swing, surface vertical rod exit devices and electromagnetic door holders
Hinges as specified
2 each Exit devices 12-8715 x ET
Function: Outside lever (from either approach side) retracts latchbolt. Egress by inside touchpad.
2 each Closers
4 each Kickplates
2 each Electromagnetic Hold-open
1 set Astragals
2 each Silencers
All wiring and connections by Division 16

GROUP 19 Pair with vertical rod exit devices (Exterior Aluminum)
Continuous Hinges as specified
2 each Integral Exit Device and concealed vertical rods by Door Mfr. prepared for lock Cylinder specified below.
Function: Key outside retracts vertical rod bolts. Outside access by pull when device is dogged. Manual dogging of exit device only by key.
2 each Door pulls – offset type.By Door Mfr.
3 each Cylinders for exit device dogging (2), and entry access at one leaf with prep. (1)
2 each Closers
1 each Overhead Stop
2 each Kick Plate
1 each Threshold
2 each Sweep
1 set Weatherstripping

GROUP 20 Pair with closers (Interior Aluminum)
Continuous Hinges as specified
2 each Integral Dummy Exit Device by Door Mfr.
Function: Entry and exit by push/pull. No locking, no dogging.
2 each Door pulls – offset type.By Door Mfr.
2 each Closers
2 each Overhead Stop
2 each Kick Plate
1 each Threshold

2 each Sweeps
1 set Weatherstripping

GROUP 21 Single
Hinges as specified
1 each Latchset Passage Function
Function: Latchbolt retracted by lever either side at all times.
1 each Stop
1 each Sound Gasketing
1 each Door Bottom

GROUP 22 Single with closer
Continuous Hinge as specified
1 each Lockset Storeroom Function
Function: Latchbolt retracted by lever inside only. Outside lever is always rigid. Key outside retracts latchbolt. Deadlocking latchbolt.
1 each Closer
1 set Weatherstripping
1 each Sweep
1 each Rain cap
1 each Threshold

GROUP 23 Single with closer (Fire-rated)
Hinges as specified
1 each Latchset Passage Function
Function: Latchbolt retracted by lever either side at all times.
1 each Closer
1 set Sound Gasketing
1 each Door Bottom
1 each Magnetic holdopen system

GROUP 24 Single
Hinges as specified
1 each Lockset Classroom (38) Security Function
Function: Latchbolt retracted by lever either side unless outside lever is locked by key. Key outside or inside locks or unlocks outside lever. Deadlocking latchbolt. Inside trim always operative, but outside lever if locked remains locked.
1 each Stop
1 set Weatherstripping
1 each Door Bottom
1 each Rain cap
1 each Threshold

END OF SECTION 08710

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This 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. Doors.
   2. Windows.
   3. Glazed entrances.
   4. Storefront framing.
   5. One Way Observation Window glazing with coated mirror-glass.
   6. Insulating sandwich panel fillers for use in storefront system in lieu of glass where indicated.
   7. Interior borrowed lites.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 8 Section "Aluminum Windows" for factory installation requirements and assembly details of units to receive insulating glass of type and configuration(s) specified herein.
   2. Division 8 Section "Aluminum Entrances and Storefronts".
   3. Division 8 Section "Flush Wood Doors".
   4. Division 8 Section "Standard Steel Doors and Frames".

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
   1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
      a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.

b. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads."
c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
   1. Load Duration: 60 seconds or less.
d. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch , whichever is less.
   1. For monolithic-glass lites heat treated to resist wind loads.
   2. For insulating glass.
e. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

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 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
   2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- wide interspace.
   3. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F .
   4. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
   5. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- square Samples for glass and of 12-inch- long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
   1. Samples: For each of the specified glass products, in the form of 12-inch- square Samples for glass.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

F. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:
   1. Insulating glass.
   2. Glazing sealants.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.

B. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.

C. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
   3. Test elastomeric glazing sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
   1. 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.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
   1. Insulating Glass Certification Council.

1.6 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 and sealing to avoid hermetic seal ruptures.

1.7 PROJECT 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.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F .

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. 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 that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select).

2.2 HEAT-TREATED FLOAT GLASS

A. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select).

2.3 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units.
   1. Provide Kind FT (fully tempered) glass for all exterior glass units to comply with glass design requirements specified in "Performance Requirements" Article.
   2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm
   3. Interspace Content: Air or Argon.
   4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
      a. Fully tempered.
   5. Outdoor Lite: ASTM C 1063 Type I, Class I (Clear) float glass, Quality q3, Sputter Coated with low emissivity soft-coat metallic-oxide compound on second surface (2).
      a. Coating: Solar Control Low-E, magnetic sputter vacuum deposition (MSVD) equal to "Solarban 60" by PPG Architectural Glass, "LoE^2" by Sunlite Insulating Glass Mfg. Ltd., or equal by Viracon.
      b. Insulating Unit Performance Requirements (Minimum):

1)	Visible light transmission:	60 – 69%
2)	Exterior reflection of	10% +/- 2
3)	Nighttime U-value – winter:	0.29
4)	Daytime U-value – summer:	0.29 – 0.31
5)	Shading Coefficient:	0.44 +/- .08
6)	Light to Solar Gain Ratio:	1.86 +/-

B. Sealing System: Dual seal, with primary and secondary sealants as follows:
   1. Manufacturer's standard sealants.

C. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.4 OBSERVATION WINDOW GLAZING

A. Products:
   1. Mirropane Series as manufactured by Pilkington or approved equitable by Designer.

B. Light Reflectance: 38%

C. Light Ratio: 7:1 Subject Side/Observer Side

D. Thickness: 6.76 mm.

2.5 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 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 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 contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

H. Insulated Filler Panel for Exterior Openings: Provide and install in Aluminum Storefront openings indicated, panels with the following characteristics, as manufactured by High Standard, Mapes, Inc., or equal:
1. Thickness: 1 inch.
2. Face Material: Baked-on high performance organic coating equal to Kynar, applied to smooth aluminum skin.
3. Stabilizer Backing Sheet: Glass fiber reinforced plastic, 0.063 inches thick.
4. Core: Polyisocyanurate (urethane) foam, not less than ¾" thick.
5. R-Value: Not less than 6, total.
6. Back Facing (interior): Baked-on high performance organic coating equal to Kynar, applied to smooth aluminum, heavy gauge skin.
7. Panel shall be formed of layers listed above structurally laminated together into a rigid, structural, sandwich-panel.
8. Finish Colors: To be selected by Design from manufacturer's full range. Allow for two colors to be selected. Face sheet and back sheet will be the same color on each panel.

2.7 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.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
1. 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 channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

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.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, 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 joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

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 where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

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 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket 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. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 PROTECTION AND CLEANING

A. Protect exterior 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, including weld splatter. 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, including natural causes, accidents, and vandalism, during construction period.

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 08800

SECTION 08950 - TRANSLUCENT PANEL GLAZED ROOF ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Arched factory-assembled insulated skylights consisting of 2-3/4 inch thick prefabricated sandwich panels and systems for installation in canopy roof areas.
      a. Type: Self flashing for mounting on field fabricated, weathertight, structural curb to be installed by Others.
      b. Translucent panels: prefabricated insulated translucent skylight sandwich panels.

B. Related Sections include the following:
   1. Division 1 Section "Alternates" for Alternates related to this section.
   2. Division 7 Section "Sheet Metal Flashing and Trim" for flashing at unit skylights.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Loads: Provide translucent units, including sandwich panels and anchorage, capable of withstanding the effects of the following design loads:
   1. Loads: As engineered by successful manufacturer for local conditions.
   2. Negative Pressure (Uplift) Load: As engineered by successful manufacturer for local conditions.

1.4 SUBMITTALS

A. Product Data: For translucent panels, skylights and components. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

C. Samples for Verification: For each type of exposed finish required, in a representative section of each unit in manufacturer's standard size.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of translucent panels that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Water leakage.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: Five years from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Kalwall Corporation.
   2. Skywall Translucent Systems, The Vistawall Group.
   3. Exterior Technologies, Inc. http://www.extech-voegele.com

2.2 TRANSLUCENT FACING

A. Translucent fiberglass faces shall be manufactured from glass fiber reinforced thermoset resins by insulated system fabricator specially for architectural use. Thermoplastic (e.g. polycarbonate, acrylic) faces and applied films are not acceptable.

B. Flammability: Both sheets shall be UL listed and have a flamespread rating no greater than 45 and smoke developed no greater than 350 when tested in accordance with UL 723. Burn extent by ASTM D-635 shall be no greater than 1". Faces shall not deform, deflect or drip when subjected to fire or flame; or become detached when subjected to 149° C for 25 minutes.

C. Weatherability:
   1. The full thickness of the exterior face shall not change color more than 3.0 CIE Units DELTA E by ASTM D-2244 after five years outdoor, determined maximum, long term color stability.

   2. The exterior face shall have a permanent glass veil erosion barrier embedded integrally to provide maximum long-term resistance to reinforcing fiber exposure. Sacrificial plastic surface films, coatings or veils are not acceptable.

D. Appearance: Wall Panel Sheets shall be smooth, .070" thick and white in color. Interior face sheets shall be .045" thick and white in color. Faces shall not vary more than 10% in translucency over the surface area.
   1. Skylight panels shall be "crystal" interior and exterior faces.

E. Strength: Interior and exterior face-sheets shall have the following impact resistance(s) per UL 972.
   1. Sheets of all panels shall be capable of resisting 70 ft. lbs. of impact force without tearing or fracture.

2.3 GRID CORE

A. The aluminum I-beam grid core shall be 6063-T6 or 6005-T5 with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 11mm. The I-beam grid shall be machined to tolerances of not greater than 0.5mm.

B. Panels shall withstand 1200°F fire for minimum one hour without collapse or exterior flaming.

2.4 ADHESIVE

A. The laminate adhesive shall be heat and pressure resin-type engineered for structural sandwich panel use, with minimum 25 years field use. Adhesive shall pass testing requirements specified by the International Conference of Building Officials "Acceptance Criteria for Sandwich Panel Adhesives".

B. Minimum tensile strength shall be 750 PSI by ASTM C-297 after two exposures of six cycles each of the aging conditions prescribed by ASTM D-1037.

C. Shear strength by ASTM D-1002 minimum after exposure to five separate aging conditions:
1. 50% Relative Humidity at 23 C: 3723 kPa
2. 82 C: 690 kPa
3. Accelerated Aging by ASTM D-1037 at room temperature: 5516 kPa
4. Accelerated Aging by ASTM D-1037 at 83 C: 1724 kPa
5. 500-Hour Oxygen Bomb by ASTM D-572: 9653 kPa

2.5 PANEL CONSTRUCTION

A. Panels shall have a thickness of 2 3/4-inch.

B. Panels shall be a true sandwich panel of flat fiberglass sheets bonded to a grid core of mechanically interlocking aluminum I-beams. Panels shall be laminated in compliance with ASTM E-72.

C. Grid pattern shall be nominal 12x24-inch shoji and symmetrical about the horizontal centerline of each panel.

D. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.

E. Panels and aluminum perimeter frame shall be pre-assembled and sealed at the factory. Panels should be shipped to the job site in rugged shipping units and shall be ready for erection.

2.6 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Closure system shall be extruded 6063-T6 and 6063-T5 aluminum clamp-tite screw type. Curved closure system may be roll formed.

B. Aluminum closures to be supplied with 300 series stainless steel screws (excluding final fastener to the building) and shall be factory sealed to the panels. Aluminum battens and cap plates shall be field installed.

C. Provide filler pieces between columns to match the panel frames.

2.7 FLEXIBLE SEALING TAPE

A. Sealing tape shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. The general contractor shall prepare openings including isolating dissimilar materials from aluminum system, which may cause damage by electrolysis, and shall provide temporary enclosures if required.

3.2 ERECTION

A. The erector shall erect translucent system in strict accordance with approved shop drawings as supplied by manufacturer. Clean aluminum perimeter frames before sealants are applied.

B. After other trades have completed work on adjacent material, carefully inspect translucent panel installation and make adjustments necessary to insure proper installation and weather-tight conditions

C. All staging, lifts and hoists required for the complete insulated installation, including staging, etc., necessary for field measuring, shall be provided by, set up and maintained by the general contractor.

3.3 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 08950

SECTION 09260 - GYPSUM BOARD and RELATED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Interior gypsum wallboard.
3. Moisture resistant Gypsum Wallboard.
4. Glassmat-faced Gypsum Core Backing Panels on walls to receive tile.
5. Non-load-bearing steel framing including interior partitions and exterior metal stud back-up framing using standard metal studs.
6. Cold Formed Metal Framing forming exterior non-loadbearing metal stud back-up framing.
7. Miscellaneous support framing at exterior and interior soffits and ceilings in designated locations.
8. Exterior Glassmat-faced Standard and Type-X Firecode Gypsum Sheathing where indicated in Drawings.
9. Blanket-type Acoustical Insulation for interior walls.
10. Metal trim accessories for standard and accent treatment of corners, edges and junctures with dissimilar materials.

B. Related Sections include the following:
1. Division 6 Section "Miscellaneous Carpentry" for wood framing, blocking, and furring.

1.3 DEFINITIONS AND REFERENCES

A. Gypsum Board Terminology: Refer to ASTMC11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

B. Minimum Uncoated Steel Thickness: Minimum uncoated steel thickness of cold-formed framing delivered to the Project Site shall be not less than 95% of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

C. AISI - Specification for Design of Cold-Formed Steel Structural Members; 1986 (1990).

D. ASTM A 653/A 654M - Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot Dip Process; 1994.

E. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings; 1993a.

1.4 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Calculate structural characteristics of cold-formed steel members according to AISI's "Specification for Design of Cold-Formed Steel Structural Members".

B. Structural Performance: Design, engineer, fabricate, and erect cold-form steel assemblies to withstand specified design loads within limits and under conditions required and indicated.
   1. Design Loads: As specified and as indicated in IBC 2003 - Structural Requirements, for region occupied by project, and applicable Sections for interior framing load capacities.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following (unless otherwise specified):
      a. Exterior Non-Load-Bearing Curtain-Wall Stud Framing: Horizontal deflection of 1/360 of the wall height where exterior finish is siding; 1/600 of the wall height for masonry veneer clad walls. Where masonry veneer does not exceed 64 inches in height, 1/360 may be used.
      b. Exterior Ceiling and Soffit Framing: Vertical deflection of 1/360 of the ceiling joist span.
      c. Interior Non-Load-Bearing Partition Framing: Horizontal deflection of 1/180 of the wall's total height when subjected to 5 psf lateral load.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg. F. (67 deg. C).
   4. Design wall framing systems to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Downward movement (vertical deflection) of 3/4 inch.
   5. Design exterior non-load-bearing curtain-wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.5 SUBMITTALS

A. Product Data: For each type of product and accessory indicated.

B. Provide shop drawings including determination of member sizes, layout, spacings, types of framing; fabrication; and details of attachment for the steel framing exposed to live load, including mechanical fasteners. Show reinforcing, channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and connection details.
   1. Shop drawings shall be prepared by, reviewed and stamped by a professional engineer licensed in the State of Maine. Include structural analysis data indicating compliance with design loads.
   2. Include complete details for all member connections at openings and other discontinuities of the wall systems.
   3. Specify connections to supporting structural steel frame at perimeter of wall panels including spacings at jambs of openings.

C. Welding Certificates: Where welding is a required means of assembly and connection of stud systems to structural steel frame, submit copies of current certificates for welding procedures and personnel capabilities.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include listing of completed projects with contact names and addresses including Owner, Designer, and other information specified.

E. Product Test Reports: From a qualified, independent testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
   1. Vertical deflection clips.
   2. Miscellaneous clips and all accessories with structural function.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed cold-formed metal framing projects similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Engineering Responsibility: Engage a qualified professional engineer who is legally qualified to practice in Maine, who is experienced in providing engineering services as follows:
   1. Engineer shall prepare design calculations, Shop Drawings, and other required structural data for design and installation of cold-formed metal framing and non-load-bearing metal stud walls where size and detail warrant engineering.
   2. Engineer shall provide seal upon calculations and shop drawings. Same engineer shall provide on-site review of installation to ensure compliance with His design.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTME119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products." or GA File Numbers in GA-600, "Fire Resistance Design Manual", or by design designations from UL's "Fire Resistance Directory".

E. AISI Specifications: Comply with AISI specifications for design and erection of cold-formed steel framing and CCFSS Technical Bulletin titled "AISI Specification Provisions for Screw Connections" for calculating structural characteristics of framing.

1.7 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 damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTMC840 requirements or gypsum board manufacturers written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Gypsum Board and Related Panel Products:
      a. American Gypsum Co.
      b. BPB America, Inc.
      c. Georgia Pacific, Inc.
      d. National Gypsum Company.
      e. United States Gypsum Co.
   2. Metal Framing Members and Accessories:
      a. Dale Industries, Inc.
      b. Dietrich Industries, Inc.
      c. MarinoWare; Div. of Ware Industries, Inc.
      d. Unimast, Inc.
   3. Blanket Insulation Products and Accessories:
      a. Certainteed
      b. Guardian
      c. Johns Manville
      d. Owens Corning

2.2 GYPSUM SHEATHING BOARD

A. Glass-Mat Gypsum Sheathing Board: ASTM C1177.
   1. Type and Thickness: Regular, 5/8 inch thick.
   2. Size: 4' x 8', 9', 10 or 12' as available for least waste.
   3. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to the following:
      a. BPB America, Inc.; "GlasRoc" sheathing.
      b. Georgia-Pacific Gypsum Corp.; "Dens-Glass Gold".

B. Glass-Fiber Sheathing Tape for Glass-Mat Gypsum Sheathing: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads per inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.
   1. Available Products: Subject to compliance with requirements, provide one of the following:
      a. Perma-Tite Tape--PGM 207A; PermaGlas-Mesh, Inc.
      b. Quik-Tape; Quik-Tape, Inc.

2.3 STEEL SUSPENDED CEILING AND SOFFIT FRAMING AND FURRING

A. Components, General: Comply with ASTMC754 for conditions indicated.

B. Tie Wire: ASTMA641/A641M, Class1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

C. Wire Hangers: ASTMA641/A641M, Class1 zinc coating, soft temper, 0.162-inch diameter.

D. Carrying Channels and hat channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch , a minimum 1/2-inch- wide flange, with ASTM A653/A653M, G40 , hot-dip galvanized zinc coating.
   1. Depth: 5/8 inch unless otherwise indicated.

2.4 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:
   1. Comply with ASTMC754 for conditions indicated.
   2. Steel Sheet Components: Complying with ASTMC645 requirements for metal and with ASTMA653/A653M, G40 , hot-dip galvanized zinc coating.

B. Steel Studs and Runners: ASTMC645.
   1. Minimum Base Metal Thickness: 22 gage.

C. Deep-Leg Deflection Track: ASTMC645 top runner with 2-inch- deep flanges.

D. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.5 COLD FORMED METAL FRAMING MEMBERS AND SYSTEMS

A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 50, Class 1 or 2 for 12 gage, 14, and 16 gage material. Grade for 18 and 20 gage material shall be 33.
   2. Coating: Provide G60 (Z275) Zinc coating.

B. Non-Loadbearing Curtain-Wall Framing:
   1. Steel Studs and Track: Manufacturer's standard C-shaped studs of web depths indicated, punched studs with stiffened flanges (unpunched track with unstiffended legs), complying with ASTM C 955, and as follows:
      a. Minimum Uncoated Steel Thickness: 0.0538 inch, 18 gage equivalent.
      b. Stud Flange Width: 1-5/8 inches minimum.
      c. Track Leg Length: 1-1/4 inch min.
   2. Steel, Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads, and as follows:
      a. Minimum Uncoated Steel Thickness: 0.0677 inch, 14 gage equivalent.
      b. Flange Width: 2-1/2 inches minimum.

2.6 FRAMING ACCESSORIES, ANCHORS, CLIPS AND FASTENERS

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated of the following types:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.

3. Web stiffeners.
4. Stud kickers, knee braces, and girts.
5. Joist hangers, and end closures.

C. Miscellaneous Steel Shapes and Clips: Provide necessary miscellaneous connectors and clips conforming to ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 time design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with capability to sustain without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

F. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

G. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure.
1. Construction: Slotted, galvanized steel angle with step bushing to prevent over tightening of fasteners.
2. Vertical Deflection: 1-1/2 inches total travel.
3. Product: Subject to compliance with requirements, provide VertiClip by Signature Industries, 919-844-0789.
4. Series: SL, SDL, SLB, and SLS as required by attachment condition.

H. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.7 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Gypsum Wallboard: ASTMC36.
1. Regular Type:
   a. Thickness: 5/8 inch unless otherwise indicated.
   b. Long Edges: Tapered
2. Type X:
   a. Thickness: 5/8 inch unless otherwise indicated.
   b. Long Edges: Tapered
   c. Location: As indicated

C. Moisture-Resistant Gypsum Wallboard:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. G-P Gypsum Corp.; DensArmor Plus Interior Panels
   b. National Gypsum Company; Gold Bond Moisture Resistant Board.
   c. United States Gypsum Co.

2. Core: Gypsum core wall panel with additives to enhance the water resistance of the core; surfaced with water repellant paper on front, back, and long edges; and complying with ASTM C 630/C 1396; OR Coated, inorganic glass mat-faced, water-resistant, treated core gypsum wallboard. Physical properties conforming to the applicable sections of ASTM C 1177 and ASTM C 630.
3. Long Edges: Tapered.
4. Location: All wet areas where wallboard is exposed and finished with paint including Restrooms, Lockers, Custodian Service Spaces, adjacent to sinks and lavatories, etc.

2.8 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Glass-faced Gypsum Core Tile Backer Units: ASTM C1178. Composition shall be water-resistant treated core with glass mat moisture protectant coating and embedded glass mats, both sides. The face side is surfaced with heat-cured copolymer water- and vapor-retardant coating.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. Georgia-Pacific Gypsum Corporation, DensShield Fireguard Type X.
2. Thickness: 5/8" unless otherwise indicated.

2.9 TRIM ACCESSORIES

A. Interior Trim: ASTMC1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized steel sheet. Plastic or vinyl trim is not acceptable.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. General: Provide extruded and machined drywall moldings in various profiles and shapes indicated. Moldings shall have a continuous integral fin for surface contact and attachment to drywall framing and boards, factory primed, ready for joint compound and paint finishing.
2. Manufacturers: Moldings meeting the requirements for the Project are available from the following:
a. Pittcon Industries, Riverdale, MD. "Softforms" SWR and SWS profiles.
b. Fry-Reglet, Alpharetta, GA. "F-reveal" mouldings and others as indicated.
3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTMB221 , alloy 6063-T5 in 0.062" thickness, minimum.

2.10 JOINT TREATMENT MATERIALS

A. General: Comply with ASTMC475.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, 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.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound
4. Finish Coat: For third coat, use setting-type, sandable topping compound

D. Joint Compound for Tile Backing Panels: As recommended by manufacturer.

2.11 INSULATION FASTENERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Adhesively Attached, Spindle-Type Anchors:
      a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
      b. Eckel Industries of Canada Limited; Stic-Klip Type N Fasteners.
      c. Gemco; Spindle Type.

B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
   1. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   2. Spindle: Copper-coated, low carbon steel, fully annealed, 0.105 inch in diameter, length to suit depth of insulation indicated.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2.12 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturers written recommendations.

B. Steel Drill Screws: ASTMC1002, unless otherwise indicated.
   1. Sheathing Screws: Use screws complying with ASTMC954 for fastening panels to steel members from 0.033 to 0.112 inch thick, in lengths recommended by sheathing manufacturer for thickness of panels to be attached. Screws shall have organic-polymer or other corrosion protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
   2. Tile Backer Panel Fasteners: For fastening tile backer units, use screws of type and size recommended by panel manufacturer, which shall be stainless steel, plated for corrosion resistance, or are hot-dip galvanized.

C. Sound Attenuation Blankets: ASTMC665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Provide water-based, highly elastic caulking that is non-staining and bleeding, remains permanently flexible and is gun-grade or pumpable. Comply with ASTM C919 and ASTM C834 with flame spread and smoke developed of 0.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devises indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTMC754, and ASTMC840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
   1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
   2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
      a. Use deep-leg deflection track where indicated.
         1. Do not permanently attach deflection track to structure to allow for movement.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers 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.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
   1. Hangers: 48 inches o.c.
   2. Carrying Channels (Main Runners): 48 inches o.c.

D. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
   1. Cut studs 1/2 inch short of full height to provide perimeter relief.
   2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

E. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   1. Install two studs at each jamb, unless otherwise indicated.
   2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
   3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

F. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3.6 INSULATION INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

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. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

E. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

F. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

G. Install fiberglass blankets in cavities formed by framing members according to the following requirements:
   1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.7 NON-LOADBEARING CURTAIN-WALL INSTALLATION

A. Install continuous track sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: Not greater than 16 inches on center.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to structure.
   2. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.

3.8 GYPSUM EXTERIOR SHEATHING INSTALLATION

A. General: Install gypsum exterior sheathing to comply with GA-253, ASTM C1280, and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8 inch setback where non-loadbearing construction abuts structural elements.

C. Coordinate sheathing installation with flashing and joint sealant installation to permit these materials to be installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

D. Install approved fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. Horizontal Installation: Install 48-inch wide gypsum sheathing boards horizontally with long edges in contact with edges of adjacent boards without forcing. Abut ends of boards centered over flanges of steel studs and stagger end joints of adjacent boards not less than one stud spacing.
   1. Screw-attach boards at perimeter and within field of board to each steel stud at approx. 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
   2. Tape all joints with specified, reinforced joint-sealing tape.

3.9 APPLYING AND FINISHING INTERIOR GYPSUM PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTMC840 and GA-216.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum 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.

E. 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.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints with space between edges of adjoining gypsum panels.

I. Cover both faces of steel stud partition 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 open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion 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 ASTMC919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

L Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
   1. Space screws a maximum of 12 inches o.c. for vertical applications.

M Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.10 PANEL APPLICATION METHODS

A. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), OR vertically at Contractor's option to maximize efficiency and quality, unless otherwise dictated or required by fire-resistance-rated assembly. Minimize end joints wherever possible.
      a. Stagger abutting end joints not less than one framing member in alternate courses of board.
      b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.11 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.12 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

B. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape. Promptly remove residual joint compound from adjacent surfaces.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C840, for locations indicated:
   1. Level 1: At joints and angles, embed tape in joint compound. Panel surfaces must be free of excess joint compound, but tool marks and ridges are acceptable.
   2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

3.13 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Designer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. Notify Designer seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
   2. Before notifying Designer, complete the following in areas to receive gypsum board ceilings:
      a. Installation, insulation, and leak and pressure testing of water piping and sprinkler systems.
      b. Installation of air-duct systems.

c. Installation of air devices.
d. Installation of mechanical system control-air tubing.
e. Installation of ceiling support framing.

B. Engineer of cold-formed metal framing shall review on-site installation and provide written documentation that installation conforms to design intent. If corrective work is required, same engineer shall specify repair work necessary to provide conforming installation.

3.14 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and paint manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures metal framing and gypsum board assemblies are without damage or deterioration at time of acceptance by other trades and until Substantial Completion.

END OF SECTION 09260

SECTION 09310 - TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Ceramic mosaic tile.
   2. Quarry tile.
   3. Glazed wall tile.

B. Related Sections include the following:
   1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
   2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   3. Division 9 Section "Gypsum Wall Board Assemblies" for Glassmat-faced Gypsum Core Tile Backer Units.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.
   2. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use

grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory for each color and finish required .
4. Metal edge strips in 6-inch lengths.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
1. Obtain tile 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 one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
1. Waterproofing.
2. Joint sealants.
3. Cementitious backer units.

1.7 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 requirement in ANSI A137.1 for labeling sealed 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 avoided.

D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT 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. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Tile Colors and Patterns: Designer may select up to three (3) colors from manufacturer's range for each tile type specified. Quantities and extent of colors will be as specified below, to be used in combination in any given room or space. Patterns shall be determined by Designer and will be based on a regular, rectilinear pattern requiring cutting of tile at perimeter of surfaces only (unless specifically indicated otherwise) as required for centering of field in area, using tile groups and percentages as follows:
   1. Ceramic Mosaics: Pattern will be achieved with 2 colors, 50% of area in each of two colors per area. Allow for 50% of all tile to be Color Group 1 and the remainder Color Group 2.
   2. Glazed Ceramic Wall Tile: No patterns, single color per room, either semi-gloss (bright) or matte. Price Group 1 shall be used throughout.
   3. Quarry Tile: Pattern will be achieved with up to 4 colors, up to 25% of area in each of the colors, per area.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.

E. 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 Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed:
   1. Daltile; Div. of Dal-Tile International Inc.
   2. American Olean; Div. of Dal-Tile International Corp.
   3. Summitville Tile, Inc., Contemporary Colored Quarry and Traditional Colored Quarry; Summitville, OH.

B. Unglazed Ceramic Mosaic Tile - [CMT]: Where this designation is indicated provide: Factory-mounted flat tile as follows:
   1. Composition: Porcelain.
   2. Module Size: 2 by 2 inches.
   3. Thickness: 1/4 inch.
   4. Face: Plain with cushion edges.

C. Unglazed Quarry Tile - [QT] Where this designation is indicated provide: Square-edged flat tile for recessed installation as follows:
   1. Wearing Surface: Nonabrasive, smooth, price group one and two in all areas except the following; Kitchen and cooler/freezer units shall receive abrasive grain, slip resistant tile, price group two.
   2. Facial Dimensions: 6 by 6 inches.
   3. Thickness: 1/2 inch.
   4. Face: Plain.

D. Glazed Wall Tile - [CT-GWT]: Where this designation is indicated provide: Flat tile as follows:

1. Module Size: 4-1/4 by 4-1/4 inches.
2. Thickness: 5/16 inch.
3. Face: Plain with cushion edges.
4. Mounting: Factory back-mounted.

E. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
1. Base for Thin-Set Mortar Installations: Straight, module size 4-1/4 by 4-1/4 inches.
2. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 4-1/4 by 4-1/4 inches.
3. External Corners for Thin-Set Mortar Installations: Surface bullnose.
4. Internal Corners: Field-butted square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

2.3 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:
1. DAP, Inc.
2. LATICRETE International Inc.
3. MAPEI Corporation.
4. Summitville Tiles, Inc.

B. Dry-Set Portland Cement Mortar: ANSI A118.1.
1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.
2. For Interior floor installation in concrete slab recesses; Dry-set Portland cement mortar bed (thinset) bonded to concrete: TCA Method F113.

C. Standard Unsanded Cement Grout: ANSI A118.6, color as indicated.

D. Standard, polymer modified, sanded cement grout meeting ANSI A118.6, for all floor areas specified to receive tile except Locker spaces. Designer will select up to 3 colors from manufacturer's full range of Standard and Designer Colors.

E. Epoxy Grout: For use on floor tile in Lockers, grout shall be two component, 100% solids, stain free epoxy system that is cold water cleanable and exceeds the ANSI A118.3 requirements for chemical resistance. Designer will select one color from Standard Range.

2.4 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. 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.

C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

2.5 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 installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
   2. 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 before installing tile.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Designer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with adhesives that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
   1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
   2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. 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.

D. 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.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Grout tile to comply with requirements of the following tile installation standards:
   1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
   1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
      a. Tile floors in wet areas.
   2. For Interior floor installation in concrete slab recesses; Dry-set Portland cement mortar bed (thinset) bonded to concrete; TCA Method F113.
      a. Grout: Standard sanded cement grout with latex add-mixture where resiliency required and recommended by manufacturer.
      b. Grout at Lockers: Epoxy grout, 2-part, stain-free system.

B. Joint Widths: Install tile on floors with the following joint widths:
   1. Ceramic Mosaic Tile: 1/16 inch.
   2. Quarry Tile: 1/4 inch.

C. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Glazed Wall Tile: 1/16 inch.

3.6 CLEANING AND PROTECTING

A. 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. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 FLOOR TILE INSTALLATION SCHEDULE

A. Tile Installation: Interior, thinset installation in recesses in concrete slab-on-grade; Dry-set Portland cement mortar; TCA F113 and ANSI A108.5.
   1. Tile Type: Unglazed ceramic mosaic and quarry tile on slabs-on-grade.
   2. Settting Mortar: Dry -set Portland cement mortar for thinset installations as indicated.
   3. Grout: Standard sanded cement grout (for all quarry and ceramic mosaic tile except at Locker) with Latex Add-mixture where resiliency required and recommended by manufacturer; ANSI A108.10.
   4. Epoxy Grout at Locker; ANSI A108.6.

3.8 WALL TILE INSTALLATION SCHEDULE

A. Tile Installation interior wall installation over sound, dimensionally stable masonry or tile backer panels on framing; thin-set mortar; TCA W202 and ANSI A108.5.
   1. Tile Type: Glazed wall tile.
   2. Thin-Set Mortar: Dry-set Portland cement mortar.
   3. Grout: Standard unsanded dry-set cement grout.

END OF SECTION 09310

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordinate Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   2. Minimum Drawing Scale: 1/4 inch = 1 foot

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTME119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
      a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
      b. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.5 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.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, 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.
   1. Acclimation: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTME 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
   1. Mounting Method for Measuring NRC: TypeE-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTME 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type indicated in **Part 3, Schedule**.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTME1264 and not manufacturers' proprietary product designations, provide products selected by Designer from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Coating-Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTMD3273.

2.2 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTMC635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
   1. High-Humidity Finish: Comply with ASTMC635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

See Article 3.5.C. in the acoustical panel ceilings schedule below for ceiling tile requiring high humidity finish requirements.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated Carbon-Steel Wire: ASTMA641/A641M, Class1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTMC635, Table1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

D. Hold-Down Clips: Where indicated, and in all entry vestibules, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 , Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTMA653/A653M, G60 coating designation, with prefinished, cold-rolled, 15/16-inch-wide.
1. Structural Classification: Intermediate duty system.
2. Face Design: Flat, flush.
3. Face Finish: Aluminum caps on flanges, painted white.

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. 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, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C636 and seismic 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. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. 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.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures 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.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and 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.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

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. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet . Miter corners accurately and connect securely.
   2. 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 a neat, precise fit.
   1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

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. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 **ACOUSTICAL PANEL CEILINGS SCHEDULE**

A. **ACT-1** - Acoustical Panels for Acoustic Panel Ceiling Type 1
1. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed
   a. Optima Open Plan #3152 by Armstrong World Industries.
2. Surface Finish: Factory-applied vinyl latex paint on nubby fabric face material.
3. Edge Detail/Grid: Square Lay-In, 24" x 24" system.
4. Acoustics - NRC: 0.95
5. Acoustics - CAC 35
6. Light Reflect: 0.89
7. Fire Resist/Flamespread: Class A (UL)
8. Texture: Nubby

B. **ACT-2** - Acoustical Panels for Acoustical Panel Ceiling Type 2:
1. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed:
   a. Clean Room Mylar Series by Armstrong World Industries.
2. Surface Finish: Soil-resistant polyester film.
3. Edge Detail/Grid: Square Lay-In, Moisture Resistive Grid, 24" x 48" system.
4. Acoustics - NRC: 0.55
5. Acoustics - CAC 35
6. Light Reflect: 0.80
7. Fire Resist/Flamespread: Class A (UL)
8. Texture: Fissured.

END OF SECTION 09511

SECTION 09651 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Vinyl composition tile (VCT).

B. Related Sections include the following:
   1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base, transition and reducer strips, and other accessories installed with resilient floor tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: Full-size units of each color and pattern of each type of product indicated.

D. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

B. Limited 5-Year Commercial Warranty for Manufacturing Defects and Wear.

1.5 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 deg F or more than 90 deg F . Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg 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 postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation and for 48 hours after floor covering installation.

D. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed in Part 2.

2.2 COLORS AND PATTERNS

A. Colors and Patterns: Each application will have up to three colors as selected by Designer, in the proportions indicated below from manufacturer's full range and as follows:
   1. Pattern and color range shall be obtained using the following formula but all tile throughout the facility shall be the same grade and price group as defined by Spec' below (Armstrong Standard Excelon, Imperial Texture or equivalent by other manufacturers listed):
      a. Field color shall comprise 50% of floor area, by space.
      b. Accents shall consist of 2 additional colors employed at approximately 25% each, by area and space.
      c. Patterns will be achieved in rectilinear layout with no cutting necessary except to center the pattern and field within the space with cuts at perimeter.

2.3 VINYL COMPOSITION TILE.

A. Vinyl Composition Tile (VCT): ASTM F 1066.
   1. Imperial Texture / Multi Color Standard Excelon as manufactured by Armstrong World Industries.
   2. Azrock Commercial Flooring, DOMCO.
   3. Mannington Mills, Inc.
   4. Tarkett Inc.

B. Wearing Surface: Smooth.

C. Thickness: 0.125 inch

D. Size: 12 by 12 inches .

2.4 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 manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
   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 resilient products.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing or pH has been neutralized sufficiently.
   3. Moisture Testing:
      a. Perform tests recommended by manufacturer but not less than Calcium Chloride Test as outlined in ASTM-F-1869. Preferably, capillary probe analysis with digital electronic moisture sensor should be performed. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   1. Do not install resilient products until they are same temperature as space where they are to be installed.

G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out 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 with pattern of tile texture running in one direction. In spaces of significantly greater length than width, run pattern widthwise.

B. Match 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.
   1. Lay tiles in pattern of colors and sizes indicated.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. 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.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas where these devices are designed to receive tile. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere 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. Perform the following operations immediately after completing resilient product 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.
      a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products 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.
   1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
      a. Coordinate selection of floor polish with Owner's maintenance group.
   2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
   3. 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. Slide or roll objects over panels without moving panels.

END OF SECTION 09651

SECTION 09653 - 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 Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wall base.
   2. Transition (jointing) molding system accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

D. Letter of Certification: For stair tread cover accessories, submit a letter from the manufacturer certifying compliance with ANSI A117.1 and the Americans with Disabilities Act for mobility and vision impairment access compliance.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide resilient stair accessories with a critical radiant flux classification of Class I, not less than 0.45W/sq. cm, as determined by testing identical products per ASTME648 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 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 degF or more than 90 degF .

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 degF or more than 95 degF 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 postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 degF or more than 95 degF

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis-of-Design Products: Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed:

2.2 COLORS AND PATTERNS

A. Colors and Patterns: As selected by Designer from manufacturer's full range

2.3 RESILIENT WALL BASE

A. Wall Base: ASTM F1861.
1. Burke Mercer Flooring Products.
2. Johnsonite
3. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
4. Roppe Corporation.

B. Type (Material Requirement): TS Rubber.

C. Group (Manufacturing Method): I (solid, homogeneous) or II (layered)

D. Style: Cove (with top-set toe)

E. Minimum Thickness: 0.125 inch

F. Height: 6 inches

G. Lengths: 120-foot coils.

H. Outside Corners: Job formed

I. Inside Corners: Job formed

J. Surface: Smooth.

2.4 OTHER RESILIENT ACCESSORIES

A. Transition (Jointing) Moldings: Provide two-piece transition molding system with resilient cap trim and metal tee-style track base for transition to various abutting finish flooring materials as detailed in Drawings. Systems acceptable for use include but may not be limited to the following:
1. Burke Mercer Flooring Products' - Series 980 with pinless metal track system in aluminum.

2. Johnsonite - CE Series cap trim with snap-in stem (sizes as necessary) with MT type track base.

2.6 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 manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated. Included shall be high-strength, quick setting accessory adhesive for track base installation equal to Johnsonite #945 Contact Bond Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
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 resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install pre-molded corners before installing straight pieces.

G. Job-Formed Corners:
1. Outside Corners: Use straight pieces of maximum lengths possible. 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. 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 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product 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.
   a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products 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.
1. Do not move heavy and sharp objects directly over floor accessories. Place plywood or hardboard panels over surfaces and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09653

SECTION 09680 - CARPET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Textured loop carpet with condensed vinyl cushion.

B. Related Sections include the following:
1. Division 1 Section "Alternates" for alternate pricing of media center carpet installation.
2. Division 9 Section "Resilient Wall Base and Accessories" and "Resilient Flooring" for resilient flooring, wall base, and accessories installed with or abutting carpet.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data and required test results on physical characteristics, backing makeup and materials, durability, and fade resistance. Include installation recommendations for each type of substrate required.

B. Samples: For each of the following products and 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. Carpet: 12-inch- square Sample.
2. Exposed Edge Stripping and Accessory: 12-inch- long Samples.
3. Carpet Cushion: 6-inch- square Sample.
4. Carpet Seam: 6-inch Sample.

C. Maintenance Data: For carpet to include in maintenance manuals specified in Division 1. Include the following:
a. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
b. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part2, as determined by testing identical products per ASTME648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI104, Section5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. General: Comply with CRI104, Section6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer on manufacturer's letterhead, agreeing to replace or repair carpet that does not comply with requirements or that fails within specified warranty period. Warranties shall not be written only for this purchase or purchaser, all shall be standard national issue. The carpet manufacturer will provide standard published written performance warranties for the following:
   1. Warranty shall be a non-prorated policy for a period of twenty-five (25) years covering:
      a. Delamination.
      b. Tuft bind, edge unravel, yarn pulls, zippering.
      c. Resiliency loss of backing and delamination of secondary backing from the primary backing containing the face fiber.
      d. Excessive surface wear, no more than 10% loss of pile fiber weight measured before and after use (ASTM D-3936).
      e. Static protection, built in protection below 3.0 kv (AATCC-134).
      f. Stain removal, carpet will resist permanent staining caused by spots and spills for the life of the carpet.
      g. Colorfastness, will not undergo a significant change in color due to exposure to light or atmospheric contaminants as tested under (AATCC-16E) at 400 hours and (AATCC-129).
      h. Backing to have a lifetime warranty against moisture penetration.
      i. Adhesive, provide a lifetime product performance warranty.

PART 2 - PRODUCTS

2.1 WOVEN CARPET

A. Products: Subject to compliance with requirements, provided the following:
   1. C&A – Monterey Crossley; Explorer Group, Style # 05175.
      a. Color: [As selected by Architect from manufacturer's full range].

b. Pattern: Manufacturer's Standard, achieved by mechanical placement of pre-dyed yarns.
c. Source: Tandus Catalog, www.tandusshowroom.com

B. Carpet Construction:
1 Yarn: 100% Nylon (Dynex SD/BCF)
2. Dye Method: Solution dyed
3. Surface Texture: Dense textured loop
4. Gauge: 1/13 – 50.4 rows/10 cm
5. Weight (including cushion): 77 oz/yd2
6. Flammability: Class 1
7. Smoke Development: less than 450
8. Width: 6 feet, manufacturer's standard maximum
9. Antimicrobial
10. ADA compliant
11. Backing: manufacturer's advanced highest performance system meeting the required tests below. Backing to be 100% free of natural latex.
12. Meeting the following required test reports.
    a. Pill Test: DOC-FF-1-70 (ASTM D-2589), Requirement - pass
    b. Flooring Radiant Panel: ASTM E-648, Requirement - Class I
    c. Optical Smoke Density Test: NFPA-258 NBS Smoke Chamber, Requirement - Less than 450, flaming mode.
    d. Moisture Penetration Test: backing passes the British Spill Test Method E Vapor Transmission and exhibits Moisture Vapor Transmission per ASTM E96.
    e. Roller Chair Caster Test: DIN Test Standard 54324
    f. CRI VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green label test
    g. Lightfastness: rating of not less than 5 on International Grey Schole after 400 hours SFU's (AATCC Test Method 16E)
    h. Colorfastness: minimum stain rating on International Grey Scale of not less than 5 wet or dry (AATCC Test Method 165)
    i. Atmospheric fading: Burned gas shall not be less than 5 on International Grey Scale after two cycles of each test (AATCC Test Method 129 Ozone/AATCC Test Method 23)

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:
1. Carpet manufacturer.

B. Adhesives: Low VOC, water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the following:
1. Carpet manufacturer.

C. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

2.3 COLORS AND PATTERNS

A. Provide up to 4 different colors of carpet throughout the project. Provide two different colors of carpet, patterned, in areas indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTMF710 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 the following:
      a. Carpet manufacturer.
   2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI104, Section6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

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 the following:
   1. Carpet manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet. 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. Direct-Glue-Down Installation: Comply with CRI104, Section8, "Direct Glue-Down Installation."

B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
   1. Bevel adjoining border edges at seams with hand shears.

C. Do not bridge building expansion joints with carpet.

D. Cut and fit carpet 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 manufacturer.

E. Extend carpet 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 finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI104, Section15, "Protection of Indoor Installations."

C. Protect carpet 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 manufacturer.

END OF SECTION 09680

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:
   1. Exposed exterior items and surfaces.
   2. Exposed interior items and surfaces.
   3. Exposed interior structural items.
   4. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
   2. High performance coatings specified herein are to be applied to the following surfaces (only) whether indicated in Drawings or not:
      a. All exposed-to-view interior concrete masonry.
   3. Color Range and Coverage: Designer reserves the option of selecting up to three (3) colors of paint finish for any particular room and a total palette of twelve (12) colors for use in the entire school.
      a. Deep hue colors: Up to three (3) deep hue colors may be selected for use in up to 10% of total surface area of project interior to receive paint - excluding ceilings - and shall be included in the total color-range allowance.
      b. Contractor shall achieve adequate coverage for appearance quality specified. Additional coat or finish thickness (where mil thickness is specified) may be required for acceptable coverage and appearance. Additional material and labor shall be provided at no additional cost to the Owner in this event.
      c. Deep Hue Colors will not be selected for surfaces to receive High Performance Coatings.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Prefinished items include the following factory-finished components:
      a. Toilet compartment doors and supports.
      b. Lockers.
      c. Finished mechanical and electrical equipment.
      d. Distribution cabinets.
      e. Exposed-to-view exterior structural steel and metal fabrications specified to receive factory finish.

f. Clay brick masonry where exposed to view on interior and exterior unless indicated specifically to receive paint.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
   a. Ceiling plenums.
   b. Pipe spaces.
3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. 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 Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
1. Division 5 Section "Structural Steel" for shop priming and some specialized factory finishing of structural steel.
2. Division 5 Section "Metal Fabrications" for shop priming of ferrous metal and some specialized factory finishing for metal fabrications exposed to exterior where indicated.
3. Division 6 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
4. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
5. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
6. Divisions15 and 16: Painting of mechanical and electrical work is specified in Divisions 15 and 16, respectively.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTMD16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
   1. After color selection, the Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
   3. Submit Samples on the following substrates for the Designer's review of color and texture only:
      a. Painted Wood: Provide two 12-inch-square samples of each color and material on hardboard.
      a. Stained or Natural Wood: Provide two 4-by-8-inch samples of natural- or stained-wood finish on actual wood surfaces.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCAP5. Duplicate finish of approved prepared samples.
   1. The Designer will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
      a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
      b. Small Areas and Items: The Designer will designate an item or area as required. Factory finished fabricated steel is excluded from this requirement.
   2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
      a. After finishes are accepted, the Designer will use the room or surface to evaluate coating systems of a similar nature.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the 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 area at a minimum ambient temperature of 45degF . Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90degF .

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95degF .

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5degF above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Names: The following manufacturers offer products that may be incorporated into the Work. Other manufacturers may be acceptable upon written approval of Designer. The indicated manufacturers may be referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
   1. Devoe & Raynolds Co. (Devoe).
   2. Benjamin Moore & Co. (Moore).
   3. California (CA).
   4. ICI / Glidden (ICI).
   5. PPG Industries, Inc. (PPG).
   6. Pratt & Lambert, Inc. (P&L).
   7. Sherwin-Williams Co. (S-W).
   8. Minwax - stains and clear wood finish (MW).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. 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. Colors: Provide color selections made by the Designer whether offered by manufacturer or not - i.e. custom color mixing may be required based on selections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. 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 the Designer about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence,

chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
c. Clean concrete floors to be painted with a 5percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
   c. When transparent finish is required, backprime with spar varnish. Open grained hardwood shall be prepared with natural wood filler in tone compatible with species of wood.
   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP10.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wirebrush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials 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.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturers written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding enamel or varnish coat.

B. 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 the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on 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 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, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. 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 the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Electrical items to be painted include, but are not limited to, the following:
1. Conduit and fittings.
2. Panel backboards.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the 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.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. 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.
1. Provide satin finish for final coats.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCAP1.

3.6 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
   1. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.
      a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.
         1. Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
         2. Moore: IronClad Retardo Rust-Inhibitive Paint #163.
         3. PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
         4. P & L: S4551 Tech-Gard High Performance Rust-Inhibitor Primer.

      b. First and Second Coats: Full-gloss, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3.0 mils .
         1. Devoe: 70XX Mirrolac Interior/Exterior Alkyd-Urethane Gloss Enamel.
         2. Moore: Impervo Enamel #133.
         3. PPG: 6-282 Speedhide Interior/Exterior Gloss-Oil Enamel.
         4. P & L: S4500 Series Tech-Gard Maintenance Gloss Enamel.

B. Exterior Gypsum Soffit Board: Provide the following finish systems over exterior gypsum soffit board:
   1. Low-Luster Acrylic Finish: 2 finish coats over a primer.
      a. Primer: Exterior, alkyd- or alkali-resistant, acrylic-latex primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils .
         1. Devoe: 1102 All-Weather Exterior Alkyd House Paint Primer.
         2. Moore: Moore's Latex Exterior Primer #102.
         3. PPG: 6-603 Speedhide Interior/Exterior Acrylic Latex Alkali Resistant Primer.
         4. P & L: S/D 1008 Suprime "8" Exterior Alkyd Primer.
      b. First and Second Coats: Low-luster (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.3 mils .
         1. Devoe: 16XX Wonder-Shield Exterior Acrylic Latex Satin House and Trim Paint.
         2. Moore: MoorGard Latex House Paint #103.
         3. PPG: 76 Line Sun-Proof Exterior House & Trim Acrylic Satin Latex.
         4. P & L: Z/F1800 Series Aqua-Shell Exterior Latex Egg-shell Paint.

3.7 INTERIOR PAINT SCHEDULE

A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:
   1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a block filler.
      a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils.
         1. Devoe: 52902 Bloxfil 200 Interior/Exterior Latex Block Filler.
         2. Moore: Moorcraft Interior & Exterior Block Filler #173.
         3. PPG: 6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.
         4. P & L: Z98 Pro-Hide Plus Latex Block Filler.
      b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils .
         1. Devoe: 39XX Wonder-Tones Semi-Gloss Interior Latex Enamel.
         2. Moore: Moore's Regal AquaGlo Vinyl-Acrylic Latex Enamel #333.
         3. PPG: 88-110 Satinhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
         4. P & L: Z/F4100 Series Accolade Interior Semi-Gloss.

B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.
      a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
         1. Devoe: 50801 Wonder-Tones Interior Vinyl Latex Primer-Sealer.
         2. Moore: Regal First Coat Interior Latex Primer & Underbody #216.
         3. PPG: 17-10 Quick-Drying Interior Latex Primer-Sealer.
         4. P & L: Z/F1004 Suprime "4" Interior Latex Wall Primer.
      b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
         1. Devoe: 34XX Wonder-Tones Interior Latex Eggshell Enamel.
         2. Moore: Moore's Regal AquaVelvet #319.
         3. PPG: 89 Line Manor Hall Eggshell Latex Wall and Trim Enamel.
         4. P & L: Z/F4000 Series Accolade Interior Velvet.

C. Woodwork and Hardboard: Provide the following paint finish systems over new, interior wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a wood undercoater.
      a. Undercoat: Alkyd- or acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recom-

mended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.

1.	Devoe:	51701 Wonder-Prime All-Purpose Latex Primer Sealer & Vapor Barrier.
2.	Moore:	Moore's Alkyd Enamel Underbody #217.
3.	PPG:	6-755 Speedhide Interior Water-Based Undercoater.
4.	P & L:	Z/F1001 Suprime "1" 100 Percent Acrylic Multi-Purpose Primer.

b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.

1.	Devoe:	39XX Wonder-Tones Semi-Gloss Interior Latex Enamel.
2.	Moore:	Moore's Regal AquaGlo Vinyl-Acrylic Latex Enamel #333.
3.	PPG:	88-110 Satinhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex.
4.	P & L:	Z/F4100 Series Accolade Interior Semi-Gloss.

D. Stained Woodwork: Provide the following stained finishes over new, interior woodwork:

1. Waterborne, Satin-Varnish Finish: 2 finish coats of a waterborne, clear-satin varnish over a sealer coat and a waterborne, interior wood stain. Wipe wood filler before applying stain.

a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.

1.	Devoe:	None required.
2.	Moore:	Benwood Paste Wood Filler #238.
3.	PPG:	None required.
4.	P & L:	None required.

b. Stain Coat: Waterborne, interior wood stain applied at spreading rate recommended by the manufacturer.

1.	Devoe:	41XX WoodWorks Waterborne Interior Stain.
2.	Moore:	Benwood Penetrating Stain #234.
3.	PPG:	77-302 Rez Interior Semi-Transparent Stain.
4.	P & L:	Z197 Acrylic Latex Stain Interior.

c. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.

1.	Devoe:	4200 WoodWorks Waterborne Quick-Dry Clear Sealer.
2.	Moore:	None recommended.
3.	PPG:	77-30 Rez Interior Quick-Drying Sealer and Finish.
4.	P & L:	Z7520 Latex Sanding Sealer.

d. First and Second Finish Coats: Waterborne, varnish finish applied at spreading rate recommended by the manufacturer.

1.	Devoe:	4300 WoodWorks Waterborne Crystal Clear Finish, Satin.
2.	Moore:	Stays Clear Acrylic Polyurethane #423, Satin.
3.	PPG:	77-49 Rez Satin Acrylic Clear Polyurethane.
4.	P & L:	Z17 Acrylic Latex Varnish, Satin.

E. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
   1. Waterborne, Satin-Varnish Finish: 2 finish coats of a waterborne, clear-satin varnish over a sanding sealer. Wipe wood filler before applying stain.
      a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
         1. Devoe: None required.
         2. Moore: Benwood Paste Wood Filler #238.
         3. PPG: None required.
         4. P & L: None required.
      b. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
         1. Devoe: 4200 WoodWorks Waterborne Quick-Dry Clear Sealer.
         2. Moore: None recommended.
         3. PPG: 77-30 Rez Interior Quick-Drying Sealer and Finish.
         4. P & L: Z7520 Latex Sanding Sealer.
      c. First and Second Finish Coats: Waterborne, varnish finish applied at spreading rate recommended by the manufacturer.
         1. Devoe: 4300 WoodWorks Waterborne Crystal Clear Finish, Satin.
         2. Moore: Stays Clear Acrylic Polyurethane #423, Satin.
         3. PPG: 77-49 Rez Satin Acrylic Clear Polyurethane.
         4. P & L: Z17 Acrylic Latex Varnish, Satin.

F. Ferrous Metal: Provide the following finish systems over ferrous metal:
   1. Full-Gloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
      a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
         1. Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
         2. Moore: IronClad Retardo Rust-Inhibitive Paint #163.
         3. PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
         4. P & L: S4551 Tech-Gard High Performance Rust Inhibitor Primer.

      b. First and Second Coats: Full-gloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.5 mils.
         1. Devoe: 84XX Mirrolac-WB Interior-Exterior Waterborne High Gloss Enamel.
         2. Moore: Impervex Enamel #309.
         3. PPG: 51 Line Brilliant Reflections Interior/Exterior Latex Gloss Enamel.
         4. P & L: Z/F4400 Series Accolade Interior High Gloss.

G. Ferrous Metal for exposed structural members and previously primed or finished metals requiring finish coats (including acoustic metal decking): Provide the following finish systems over ferrous metal for exposed structural members and where indicated:

a. First and Second Coats: Acrylic dry fog Primer/Finish system:

1) Devoe: Multi-Plex WB - Primer and Finish.

2) P & L: Tech-Gard Alkyd Semi-Gloss Dry Fall.

(NOTE: Exposed Architectural Structural Steel (EASS) in exterior location is specified to be Shop-finished as part of the Work of the related Division 5 Sections).

END OF SECTION 09900

SECTION 10101 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Porcelain enamel markerboards - typical throughout school.
   2. Simulated fabric, vinyl faced, framed tackboards.

1.3 SUBMITTALS

A. Product Data: For each type of visual display board indicated.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:
   1. Markerboards: Actual sections of porcelain enamel finish for each type of markerboard required.
   2. Tackboards: Actual sections of tackboard material.

C. Samples for Verification: Of the following products, showing color and texture or finish selected. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected. Prepare Samples from the same material to be used for the Work.
   1. Visual Display Boards: Sample panels not less than 8-1/2 by 11 inches , mounted on the substrate indicated for the final Work. Include a panel for each type, color, and texture required.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display boards and display cases through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.

3. Field measure and confirm layout of all bulletin board installations to assure proper alignment with frames of doors and windows, and masonry coursing.

1.6 WARRANTY

A. General Warranty: The special porcelain enamel chalkboard warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Porcelain Enamel Chalkboard Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel chalkboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.
1. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Porcelain Enamel Markerboards and Tackboards:
   a. Best-Rite Chalkboard Co.
   b. Carolina Chalkboard Co.
   c. Claridge Products and Equipment, Inc.
   d. Polyvision, Div. Of Steelcase
   e. Greensteel, Inc.

2.2 MATERIALS

A. Porcelain Enamel Markerboards: Balanced, high-pressure-laminated, porcelain enamel chalkboards of 3-ply construction consisting of face sheet, core material, and backing.
1. Face Sheet: 0.024-inch enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1200degF .
2. Core: 3/8-inch-thick, particleboard core material complying with requirements of ANSIA208.1, Grade 1-M-1.
3. Backing Sheet: 0.015-inch-thick, aluminum-sheet backing.

B. Vinyl Fabric: FS CCC-W-408, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested according to ASTM E 84.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

D. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

E. Vinyl-Fabric-Faced Tack Assembly: Vinyl fabric factory laminated to 1/2-inch-thick fiberboard backing.

2.3 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.
   1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Designer from manufacturer's standard structural support accessories to suit conditions indicated.
   2. Field-Applied Trim: Manufacturer's standard screw-on trim with Phillips flat-head screws.
   3. Chalktray: Manufacturer's standard, continuous, box-type, aluminum chalktray with slanted front and cast-aluminum end closures for each markerboard.
   4. Map-rail: At each markerboard and markerboard/tackboard provide manufacture's standard continuous aluminum map-rail with cork insert and cast aluminum end closures. Provide the following accessories:
      a. Provide four map hooks with flexible metal clips per rail.
      b. Flag Holder: One for each room.
      c. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

2.4 FABRICATION

A. Porcelain Enamel Chalkboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.

B. Assembly: Provide factory-assembled chalkboard and tackboard units, unless field-assembled units are required.
   1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Designer.
   2. Provide manufacturer's standard vertical joint system between abutting sections of chalkboards.
   3. Provide manufacturer's standard mullion trim at joints between chalkboards and tackboards.

2.5 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.
   1. Surfaces to receive chalkboards or markerboards shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of chalkboards or markerboards.
   2. Surfaces to receive tackboards and bulletin boards shall be dry and free of substances that would impair the bond between tackboards and substrate.
   3. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible for field applied installation. If dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Designer. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

C. Coordinate Project-site-assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.3 ADJUSTING AND CLEANING

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units according to manufacturer's written instructions.

END OF SECTION 10101

SECTION 10155 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes toilet compartments and screens as follows:
   1. Type: Solid-plastic, polymer resin.
   2. Compartment Style: Floor anchored, overhead braced.
   3. Screen Style: Wall hung.

B. Related Sections include the following:
   1. Division 10 "Toilet and Bath Accessories" for toilet paper holders, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.

C. Samples for Verification: Of each compartment or screen color and finish required, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: The design for each toilet partition system specified in the Part 2 Article below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.
   1. Bradley Corporation; Mills Partitions - Sentinel Series.
   2. Comtec Industries, Westmont, NJ.

3. General Partitions, Erie, PA
4. Santana Products, Inc.

2.2 MATERIALS

A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.

B. Solid-Plastic, Polymer Resin: High-density polyethylene (HDPE) with homogenous color throughout. Provide material not less than 1 inch thick with seamless construction and eased edges in color and pattern as follows:
   1. Color and Pattern: One color and pattern in each room as selected by Designer from manufacturer's full range of colors and patterns.

C. Pilaster Shoes and Sleeves (Caps): ASTMA666, Type 304 stainless steel, not less than 0.0312 inch thick and 3 inches high, finished to match hardware.
   1. For solid-plastic, polymer-resin pilasters, in lieu of stainless-steel pilaster shoes and sleeves, manufacturer's standard plastic pilaster shoes and sleeves may be provided.

D. Stirrup Brackets: Manufacturer's standard full-height, wall brackets for attaching panels and screens to walls and pilasters of the following material:
   1. Material: Extruded aluminum in clear anodized finish.

E. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of the following material:
   1. Material: Stainless steel.

F. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile in manufacturer's standard finish.

G. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide hex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
   1. Provide internal reinforcement in metal units for compartment-mounted hardware, accessories, and grab bars, as indicated.

B. Solid-Plastic, Polymer-Resin Compartments and Screens: Provide aluminum heat-sink strips at exposed bottom edges of HDPE units to prevent burning.

C. Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

D. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.

E. Doors: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide swinging doors with a minimum 32-inch-wide clear opening for compartments indicated to be handicapped accessible.
   1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.

2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting adjacent construction.
4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.
5. Door Pull: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch between pilasters and panels and not more than 1 inch between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
   1. Secure panels to walls and panels with continuous stirrup brackets attached to wall at not less than 2'-0" on center, each side of bracket attachment leg where applicable. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.

B. Floor-Anchored Compartments: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than 2 fasteners. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10155

SECTION 10431 - SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Panel signs for ADA compliance and room identification.
   2. Individual metal letters for post mounting in interior and exterior applications.
   3. Cast bronze, custom lettered dedication plaque for lobby and as indicated on Drawings.

B. Related Sections include the following:
   1. Division15 Section "Mechanical Identification" for labels, tags, and nameplates for mechanical equipment.
   2. Division16 Section "Electrical Identification" for labels, tags, and nameplates for electrical equipment.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
   1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and Braille layout.

C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.
   2. Fabricator shall anticipate that one panel sign will be required at ALL entrance doors to every space in the building affected by or added by this Project. Text shall match Room Name indicated in Room Finish Schedule on Drawings.

B. Available Manufacturers:
   1. American Graphics Inc.
   2. ASI Sign Systems, Inc.
   3. Best Manufacturing Co.
   4. Signature Signs, Inc.
   5. Welch Architectural Signage (207) 883-6200.

C. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:
   1. Edge Condition: Square cut.
   2. Corner Condition: Rounded to radius indicated.

D. Graphic Content and Style: Provide sign copy that complies with requirements indicated on Drawings for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.
   1. Provide in sign face, a routed slot with clear lens cover designed to receive a replaceable name strip for rooms with assigned staff such as classrooms and offices.

E. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSIA117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   1. Panel Material: Laminated impact acrylic sheet, reverse engraveable, 1/8-inch thick with matte finish.
   2. Raised-Copy: Not less than 1/32-inch thick, opaque acrylic sheet with matte finish.
   3. Colors: As selected by Designer from manufacturer's full ranges.

2.3 CAST-METAL PLAQUES

A. General: Provide castings free from pits, scale, sand holes, and other defects. Comply with requirements specified for metal, border style, background texture, and finish and in required thickness, size, shape, and copy.

B. Bronze Castings: ASTMB584, alloy UNS No.C83600 (No.1 manganese bronze).

C. Border Style: Raised flat band.

D. Background Texture: Manufacturer's standard stipple texture finished with baked enamel dark brown background. Entire plaque is final finished with a two-part, hardened acrylic polyurethane clearcoat.

E. Mounting: Solid wall mount on masonry with exposed bronze oval-head screws and ½ inch diameter rosettes.

F. Lettering: Provide text quantity and format indicated on Drawings. Font shall be Clarendon or similar, standard font.

2.4 CAST METAL INDIVIDUAL LETTERS

A. General: Provide cast metal letters that are free if pits, scale, sand holes, and other defects, for interior and exterior applications. Comply with requirements specified for metal, face style and finish and in required thickness, size, shape, and copy.
   1. Letters required include:
      a. Exterior applications forming the words "Riverton Elementary School" and "Riverton Community Center" in locations on Entry facades as shown, attached to the pediments of the canopies.
      b. Font: Century Schoolbook Bold or equal.
      c. Size: 9-inches tall x ½ inch thick.

B. Metal and Finishes: Letters shall be fabricated from prime aluminum ingots of pure alloy #319. Completed letters shall be clear anodized by fabricator for all interior locations in conformance with AAMA 611 to #204 (Class II), 0.4 mil thickness. Exterior letters shall receive a baked-on epoxy powdercoat finish, equal to Tiger Coatings, in standard recommended thickness, available from the fabricator. Designer shall select coating color from manufacturer's full range available.

C. Mounting: Provide projected spacer stud-type mounting with stainless steel threaded studs for embedment in drilled and threaded holes in face of wall or panel to receive threaded support studs for letters.

2.5 ACCESSORIES

A. Mounting Methods: Use double-faced adhesive foam tape for all appropriate interior locations with smooth substrate.
   1. At exterior and rough, porous substrates, use silicone adhesive fabricated from materials that are not corrosive to sign material and mounting surface.

2.5 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

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 work.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
   1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
   2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
   1. Foam Tape Mounting: Use double-sided vinyl tape where recommended in writing by sign manufacturer. Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces.

C. Exterior Individual Metal Lettering: Drill and tap steel structure in locations to receive letters using template provided. Attach studs to steel framing and mount letters thereto.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10431

SECTION 10505 – LOCKERS AND ACCESSORIES

PART 1. - GENERAL

A. RELATED DOCUMENTS

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. SUMMARY

1. This Section includes plastic lockers and related equipment as indicated on Drawings.
2. Type of products in this section include the following:
   a. Double-tier Athletic lockers.
   b. Locker fittings and accessories.
3. Masonry base for lockers is specified in Division 4.
4. Wood sleepers are specified in Division 6.

C. SUBMITTALS

1. Submit the following in accordance with Conditions of Contract and Division Specification sections.
   a. Product data and installation instructions for metal locker units.
   b. Color Samples of squares of same material to be used for fabrication of lockers.
   c. Shop Drawings that show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

D. QUALITY ASSURANCE

1. Uniformity: Provide plastic lockers that are standard products of single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

E. JOB CONDITIONS

1. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

PART 2. - PRODUCTS

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to,

the following:

a. Comtec Industries, Inc., Moosic, PA
b. Santana Plastic Products, Inc., Scranton, PA

B. MATERIALS

1. Plastic Sheet: High pressure formed high-density polyethylene (HDPE) solid plastic with standard thicknesses and details indicated below.
2. Latches and Hinges: Fabricated from PVC plastic, securely fastened to panels with snap-fit connection system along entire length of door panels and, for hinge, along locker body as well.
3. Clothes Hooks: Chromium or nickel plated steel attached with aluminum rivets.

C. FABRICATION, GENERAL

1. Construction: Fabricate lockers square, rigid, and without warp, with HDPE surfaces flat and free of scratches, chips, dents or distortion. Ease exposed edges to make safe to touch. Do not expose bolts or rivet heads on fronts of locker doors or frames.
2. Finish: HDPE surfaces shall be standard "orange-peel" texture and available in manufacturer's full range of standard, solid colors and all other plastic components shall match. Architect may select up to two colors from full range for project
   a. Apply protective masking coating to all exposed surfaces for protection during shipping and installation.

D. ATHLETIC LOCKERS

1. Locker Arrangement: Double tier as indicated on Drawings.
   a. Size: All lockers shall be 16 inches x 16 inches x 36 inches high.
2. Door: Manufacturer's standard solid HDPE plastic, ½" thick with homogeneous color through entire thickness.
   a. Designer will select venting style option from series of options available.
3. Sides, tops, bottoms, backs and shelves: Solid HDPE plastic, 3/8" thick minimum, with homogeneous color through entire thickness. Machine edges to receive accept assembly brackets.
4. Hinges: Heavy-duty continuous piano-style PVC hinge with no steel or metal parts., full-loop, 5-knuckle, tight pin, 2 inches high. Snap detail shall secure hinge onto frame and secure to door completely concealed and tamperproof when door is closed.
5. Latching: Provide continuous PVC latching device, engaging frame along entire jamb, with provisions for padlock.

E. LOCKER ACCESSORIES

1. Equipment: Furnish each locker with the following items, unless otherwise shown:
   a. Double-Tier Units: One double-prong hook and not fewer than 2 single-prong wall hooks.

b. Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous metal number plates with numerals not less than 3/8 inches high. Number lockers in sequence as directed by Designer. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

2. Filler Panels: Provide filler panels where indicated, and as required for closure on ends of a wall-to-wall run, of not less than ½" thick HDPE sheet, factory fabricated and in color to match locker units.

PART 3. - EXECUTION

A. INSTALLATION

1. Install lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.
2. Space fastenings about 48 inches o.c., unless otherwise recommended by manufacturer, and apply through backup reinforcing where necessary to avoid distortion, using concealed fasteners.
3. Install trim, filler panels and end panels, using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

B. ADJUST AND CLEAN

1. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.
2. Touch-up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10505

SECTION 10520 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Portable fire extinguishers.
2. Fire-protection cabinets for portable fire extinguishers.

B. Related Sections include the following:
1. Division 7 Section "Firestopping" for firestopping sealants at fire-rated cabinets.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
1. Fire Extinguishers: Include rating and classification.
2. 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 Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
1. Provide extinguishers listed and labeled by FM Global. Approval Guide 2000—Fire Protection: A Guide to Equipment Materials & Services Approved by Factory Mutual Research for Property Conservation. Johnston, RI: FMG, 2000.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Portable Fire Extinguishers:
      a. Amerex Corporation.
      b. Ansul Incorporated.
      c. Badger; Div. of Figgie Fire Protection Systems.
      d. Buckeye Fire Equipment Company.
      e. Fire-End & Croker Corporation.
      f. General Fire Extinguisher Corporation.
      g. J.L. Industries, Inc.
      h. Kidde: Walter Kidde, The Fire Extinguisher Co.
      i. Larsen's Manufacturing Company.
      j. Modern Metal Products; Div. of Technico.
      k. Moon/American, Inc.
      l. Pem All; Div. of Pem Systems, Inc.
      m. Potter-Roemer; Div. of Smith Industries, Inc.
      n. Samson Products, Inc.
      o. Watrous; Div. of American Specialties, Inc.
   2. Fire-Protection Cabinets:
      a. Filtrine Manufacturing Company.
      b. Fire-End & Croker Corporation.
      c. General Accessory Manufacturing Co.
      d. J.L. Industries, Inc.
      e. Larsen's Manufacturing Company.
      f. Modern Metal Products; Div. of Technico.
      g. Moon/American, Inc.
      h. Potter-Roemer; Div. of Smith Industries, Inc.
      i. Samson Products, Inc.
      j. Thomas Enterprises.
      k. Watrous; Div. of American Specialties, Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
   1. Sheet: ASTMB209 .
   2. Extruded Shapes: ASTMB221 .

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:80:B:C, 10-lb nominal capacity, in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter doorframes.
   1. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
      a. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
      b. Provide factory-drilled mounting holes.
   2. Cabinet Metal: Aluminum sheet.
   3. Shelf: Same metal and finish as cabinet.

B. Cabinet Type: Suitable for the following:
   1. Fire extinguisher.

C. Cabinet Mounting: Suitable for the following mounting conditions:
   1. Semirecessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.

D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
   1. Exposed Trim: One-piece combination trim and perimeter doorframe overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
      a. Rolled-Edge Trim: 4-inch backbend depth.

E. Cabinet Trim Material: Manufacturer's standard, as follows:
   1. Extruded-aluminum shapes.

F. Door Material: Manufacturer's standard, as follows:
   1. Aluminum sheet.

G. Door Glazing: Manufacturer's standard, as follows:
   1. Tempered Float Glass: ASTMC1048, Kind FT, Condition A, Type I, Quality q3, as follows:
      a. Class 1 (clear).

H. Door Style: Manufacturer's standard design, as follows:
   1. Fully glazed panel with frame.

I. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
   1. Provide minimum 1/2-inch-thick doorframes, fabricated with tubular stiles and rails, and hollow-metal design.

J. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide recessed, concealed door pull and friction latch to comply with ADA. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.5 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
1. Provide brackets for extinguishers not located in cabinets.

B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Designer.
1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
a. Application Process: Vinyl letters.
b. Lettering Color: Red.
c. Orientation: Vertical.
2. Wall Mounted 3-Dimensional Indicator: Provide and install at each semi-recessed F.E. cabinet, a 3-way visible wall mounted sign above the extinguisher equal to PM43547-"Standard" with arrow, as manufactured by EMED Co., Buffalo, NY or approved equal.

2.6 COLORS AND TEXTURES

A. Colors and Textures: As selected by Designer from manufacturer's full range for these characteristics.

2.7 FINISHES, GENERAL

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: 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.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi recessed cabinets are to 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 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
   1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
   2. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets, doors and extinguishers are without damage or deterioration at the time of Substantial Completion.

D. Extinguishers shall be provided with current and valid inspection tags, acceptable to Local Authority.

END OF SECTION 10520

SECTION 10651 - OPERABLE PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Manually operated, side-stacking, multi-directional, individual panel partition system.

B. Related work specified elsewhere:
   1. Section 04200 "Unit Masonry".
   2. Division 5 Section "Structural Steel" for steel support structure carrying partition tracks.
   3. Section 09250 "Gypsum Board".
   4. Section 09512 "Acoustic Tile Ceilings".

1.3 DEFINITIONS

A. NIC: Noise isolation class.

B. NRC: Noise reduction coefficient.

C. NVLAP: National Voluntary Laboratory Accreditation Program.

D. STC: Sound transmission class.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
   1. Acoustical performance shall be tested at a laboratory accredited by the U.S. Dept. of Commerce, National Institute of Standards and Technology, under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of 47.

1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified. Include data on acoustical performance, surface-burning characteristics, and durability.

B. Shop Drawings: Show location and extent of operable panel partitions. Include plans, elevations, sections, details, numbered panel installation sequence, attachments to other construction, and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation re-

quirements for hardware and track, and direction of travel. Show blocking to be provided by others. Include the following:

1. Calculations: Calculate requirements for supporting operable panel partitions and verify capacity of carriers and track components to support loads; indicate deflection limits for partition and adjacent construction.

C. Setting Drawings: For embedded items and cutouts required in other work, including support beam punching template.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
   1. Include similar Samples of accessories involving color selection.

E. Product Certificates: Signed by manufacturers of operable panel partitions certifying that products furnished comply with requirements.

F. Product Test Reports: From a qualified testing agency indicating that each operable panel partition complies with requirements, based on comprehensive testing of current products.

G. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:
   1. Panel face finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
   2. Seals, hardware, track, carriers, and other operating components.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide operable panel partitions with the following fire-test-response characteristics, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: As follows, per ASTM E 84:
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 450 or less.

B. Installer Qualifications: The operable panel partitions shall be installed by qualified, factory trained craftsmen, skilled in this trade, and acceptable to the manufacturer of the operable panel partition systems.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and storage dimensions and proceed with fabricating operable panel partitions without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide either the named product or comparable product by one of the other manufacturers listed that exactly complies with the function, style, and operation characteristics indicated:

B. Individual Panel, Side-stacking System: Provide manually operable partition system for subdivision of multi-purpose room in Community Wing as indicated on the Drawings.
1. Hufcor Inc.; Series 5600-R
2. Modernfold, Inc.
3. Panelfold, Inc.; Model 410 PP (Pre-programmed)
4. Kwik-Wall Moveable Wall Systems, Dixon, IL; 2000 Series.

2.2 MATERIALS

A. Steel Frame: Steel sheet, not less than 0.0478-inch nominal specified thickness for uncoated steel.

2.3 OPERABLE PANEL PARTITIONS

A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

B. Dimensions: Fabricate operable panel partitions, from manufacturer's standard sizes, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.

C. Acoustic Performance: Operable panel and perimeter seal system exactly like products specified shall have a proven minimum **STC Rating of 47** as tested by an independent acoustical laboratory in accordance with ASTM E90-81 test procedures in a full scale 14'-0" by 9'-3" opening.

D. Cap-Trimmed Edges: Protective aluminum perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.

E. Trim: Manufacturer's standard aluminum trim, finished as follows:
1. Color: Anodized, color to be selected by Designer from full range of manufacturer's standard colors.

F. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish. Provide manufacturer's standard, heavy-duty, butt-type hinges for hinge points of all paired panels.

G. Closure: Final closure shall be effected by the following method as applicable to series and lo cation:
   1. Individual Panel, Side-stacking System in Cafetorium and Gymnasium shall be closed by expandable panel.

H. Panels: Operable Acoustic Panels shall be flat, 3" thick and nominally 49" wide. Panel faces shall be laminated to metal frames. Panels shall be top supported and have appropriate internal insulation to achieve specified STC.
   2. The tops of the panels shall be structurally reinforced to withstand forces of the suspension components and operation.
   3. Hanging weight of panels shall not exceed 8 lbs./sq. ft.

2.4 SEALS

A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
   1. Seals made from materials and profiles that minimize sound leakage.
   2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track when extended.

D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
   1. Manual Lever-operated: Extension and retraction of bottom seal manually operated by operation of removable lever or actuator tool, with operating range not less than the 1-inch operating clearance between retracted seal and floor finish.

2.5 FINISH FACING

A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
   1. Apply one-piece, seamless facings free from air bubbles, wrinkles, blisters, and other defects, complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   2. Where facings with directional or repeating patterns or directional weave or directional, repeating, or matching grains are indicated, mark facing top and attach facing in same direction.
   3. Match facing pattern 72 inches above finished floor.

B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-B for Type indicated; Class A.

1. Antimicrobial Treatment: Additives capable of inhibiting growth of microbes, including, but not limited to, Staphylococcus aureus, Escherichia coli, and Aspergillus niger.

2.6 SUSPENSION SYSTEMS

A. Suspension Tracks: Aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
   1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
   2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Aluminum Finish: Manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557, operable panel partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.

C. Apply perimeter caulking and trim as required.

D. Match operable panel partitions for color and pattern by installing panels from marked packages in numbered sequence indicated on Shop Drawings.

E. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.3 ADJUSTING

A. Adjust operable panel partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

B. Demonstrate operation to Owner's Representatives as required and specified in Division 1.

3.4 CLEANING AND PROTECTION

A. Clean soiled surfaces, fabric facing, metal surfaces, on completing installation of operable panel partitions, to remove dust, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.

C. Replace panels that cannot be cleaned and repaired, in a manner approved by Designer, before time of Substantial Completion.

END OF SECTION 10651

SECTION 10801 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Toilet room accessories.
   2. Shower room accessories.

B. Owner-Furnished Materials for Contractor Installation (OFCI):
   1. Paper Towel Dispensers
   2. Toilet Paper Holders
   3. Soap Dispensers

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. Manufacturer's warranty.

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 products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.5 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.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-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/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, 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.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
      a. A & J Washroom Accessories, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation.

B. Waste Receptacle:
   1. Basis-of-Design Product: Bobrick, B-277 "Contura" Series.
   2. Mounting: Surface mounted.
   3. Minimum Capacity: 12 gallon.
   4. Material and Finish: Stainless steel, No. 4 finish (satin).
   5. Liner: Reusable vinyl liner.

C. Grab Bar (GB):
1. Basis-of-Design Product: Bobrick, B6806 Series, Straight.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: Where indicated on Drawings, Straight, 36 and 42 inches long.

D. Sanitary-Napkin Disposal Unit (SND):
1. Basis-of-Design Product: Bobrick, B-270 "Contura".
2. Mounting: Surface mounted at 25-30 inches to top.
3. Door or Cover: Drawn, one-piece stainless steel disposal-opening cover hinged full length with stainless steel piano hinge..
4. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Channel Frame Mirror Unit (MIR):
1. Basis-of-Design Product: Bobrick, B-165 Series.
2. Frame: Type 430 continuous stainless-steel channel.
   a. Corners: Manufacturer's standard, Mitered and mechanically interlocked.
3. Hangers: Produce rigid, tamper-and theft-resistant installation, using method indicated below.
   a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Mirror Size: All channel framed mirror units shall be 24 inches wide x 36 inches tall.

F. Schedule of Toilet Room Accessories:
1. All Toilet Rooms with Single Toilet shall receive (in addition to items indicated); one Waste Receptacle, and one Channel Frame Mirror centered over each lavatory. Locations not otherwise shown shall be determined in field by Designer.
2. In addition all toilet rooms designated as Girls' and Women's Lavatories shall receive (in addition to items indicated) one (1) Sanitary Napkin Disposal Unit in each stall.

2.3 SHOWER ROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.

C. Shower Curtain Rod:
1. Basis-of-Design Product: Bobrick, B-6047 "Classic" Series extra-heavy duty.
2. Description: 1-1/4-inch OD; fabricated from nominal 18-gauge, Type 304 stainless steel, in length to suit openings.
3. Mounting Flanges: Stainless-steel 2-1/2-inch square flanges designed for exposed fasteners.

4. Finish: No. 4 (satin).

D. Shower and Dressing Area Curtain:
1. Size: Minimum 12 inches wider than opening by 72 inches high.
2. Material: Duck, minimum 8 oz., white, 100 percent cotton.
3. Color: As selected from manufacturer's full range.
4. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

E. Folding Shower Seat:
1. Basis-of-Design Product: Bobrick, B-5181 Reversible, ADA seat.
2. Configuration: L-shaped seat, designed for wheelchair access
3. Seat: Phenolic, 1/2-inch thick, one-piece construction in ivory color with slots for drainage.
4. Mounting Mechanism: No. 304 Stainless steel, No. 4 finish (satin) with self-locking mechanism, reversible for left or right hand installation.
5. Dimensions: 33 x 22 inches, mounted 18 inches from floor, 400lb. capacity.

2.4 FABRICATION

F. 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.

G. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of twenty (20) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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. Grab Bars: Install to withstand a downward load of at least 250 lb., when tested according to method in 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 recommendations.

END OF SECTION 10801

SECTION 11132 – PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Front-projection manually operated, surface wall mounted screens – in locations indicated in Drawings.

B. Related Sections include the following:
   1. Division 6 Section "Miscellaneous Carpentry" for blocking in walls to mount screens above marker boards in classrooms as required.

1.3 DEFINITIONS

A. Gain: Ratio of light reflected from or refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per FSGG-S-00172D(1).

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 SUBMITTALS

A. Product Data: For each type of screen specified.

B. Shop drawings showing dimensions and method of attachment.

C. Samples of finishes for selection by Architect.

D. Manufacturer's installation and maintenance instructions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware, and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Da-Lite Screen Co., Inc.- Model C with CSR
   2. Draper Shade & Screen Co., Inc. - Silhouette Series M

2.2 MANUALLY OPERATED SCREENS:

A. Provide manufacturer's standard spring-roller-operated units designed and fabricated for wall or ceiling installation and consisting of case, screen, mounting accessories, and other components necessary for a complete installation.

B. Screen Case: Fabricated in 1 piece from steel sheet not less than 0.0299 inch (0.75 mm), with flat back design and vinyl covering or baked-enamel finish. Provide end caps with integral roller brackets and universal mounting brackets, finished to match end caps, for wall or ceiling mounting.

C. Screen Mounting: Top edge securely anchored to a 3-inch- (75-mm-) diameter, rigid steel spring roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and saddle and pull attached to slat by screws.

D. Sizes: Standard 43 x 57-inches (H x W) for all typical locations indicated

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of projection screens with construction and related components penetrating or above mounting location such as lighting fixtures, mechanical equipment, ductwork, and fire-suppression system.

B. Coordinate requirements for blocking, structural supports, and bracing to ensure adequate means for installation of screens.

3.2 INSTALLATION

A. General: Install projection screens at locations indicated on Drawings. Comply with screen manufacturer's written instructions.

B. Install projection screens with screen cases in position and relationship to adjoining construction indicated. Provide blocking for wall-mounted locations as required. 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.

C. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and, level with viewing surface flat when screen is lowered.
   1. Test manually operated units to verify that screen operating components are in optimum functioning condition.
   2. Correct deficiencies.

D. Provide required brackets, hanger rods, and fasteners.

3.2 PROTECTING AND CLEANING

A. Protect projection screens after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11132

SECTION 12484 - FLOOR MATS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Carpet-type mats.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's specifications and installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of floor mat and trim accessory specified.

B. Samples for Initial Selection: For each type of floor mat and trim accessory indicated or required, submit manufacturer's full range of standard colors available, for selection by Designer.

C. Samples for Verification: 12-inch-square assembled sections of floor mats showing each color of exposed floor mats.

D. Maintenance Data: For cleaning and maintaining floor mats to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, provide installed floor mats that comply with Section4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

B. Flammability in accordance with ASTM E648, Class I, Critical Radiant Flux, minimum 0.45 watts/m2.

C. Slip resistance in accordance with ASTM D-2047-96, Coefficient of Friction, minimum .060 for accessible routes.

1.5 COORDINATION

A. Coordinate size and location of oversized recesses in concrete work to receive floor mats. Concrete, reinforcement, and formwork requirements are specified in Division3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Modular Carpet-Type Mats:
      a. Mats Incorporated; Diagonal Tiles manufactured by Vebe.
      b. American Floor Products Company, Inc.
      c. Entrance, Inc.

2.2 FLOOR MATS

A. General: Provide colors, patterns, and profiles of materials, indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Designer from manufacturer's standards.

B. Carpet-Type Mats: Polypropylene nonwoven carpet tiles of solution dyed fiber bonded to 1/8 to 1/4-inch-thick, flexible felt backed bitumen backing to form mats 0.37 inch-thick with non-raveling edges. Total material weight shall be 129.5 oz./sq. yd.
   1. Tapered Flexible Molding: Where required by locations with no abutting material of thickness equal to mats, provide tapered vinyl carpet edge moldings with flanges fused to back of mat at all applicable edges, with mitered corners where adjacent edges receive molding.
   2. Primary backing: Bitumen based polymer or approved equal.

2.3 FABRICATION

A. General: Where possible, verify sizes by field measurement before shop fabrication.

B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

C. Frames: Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

3.2 PROTECTION

A. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION 12484

SECTION 12491 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of venetian blinds and accessories:
   1. Miniblinds with aluminum louver slats as scheduled on window and or finish schedule of the Drawings.

1.3 DEFINITIONS

A. Miniblind: Venetian blind with nominal 1-inch-wide louver slat.

1.4 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 horizontal louver blinds. Include 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.

C. Samples for Initial Selection: For each colored component of each type of horizontal louver blind indicated.
   1. Include similar Samples of accessories involving color selection.

D. Window Treatment Schedule: Include horizontal louver blinds in schedule using same room designations indicated on Drawings.

E. Product Certificates: For each type of horizontal louver blind product, signed by product manufacturer.

F. Product Test Reports: For each type of horizontal louver blind product.

G. Maintenance Data: For horizontal louver blinds to include in maintenance manuals. Include the following:
   1. Methods for maintaining horizontal louver blinds and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to finishes and performance.
   3. Operating hardware.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide horizontal louver blinds 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 NFPA701.

C. Corded Window Covering Product Standard: Provide horizontal louver blinds complying with WCMAA100.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds 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 operable glazed units' operation hardware throughout the entire operating range. Notify Designer of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Horizontal Louver Blinds, Aluminum Louver Slats:
      a. Hunter Douglas Window Fashions.
      b. Levolor Contract; a Newell Company; Levolor.
      c. Springs Window Fashions Division, Inc.; Bali or Graber.
      d. Verosol USA, Inc.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM LOUVER SLATS

A. Louver Slats: Aluminum, alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
   1. Nominal Slat Width: 1 inch for miniblinds.
      a. Slat Spacing: Every 3/4 inch (18 mm) for 16.7 slats or more per foot .
   2. Nominal Slat Thickness: Not less than 0.008 inch .
   3. Slat Finish: One color as indicated.

B. Headrail/Valance: Decorative, integrated headrail/valance not requiring a separate valance or end brackets for finished appearance; formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and ends; capacity for one blinds per headrail, unless otherwise indicated on Drawings

C. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends, with top contoured to match crowned shape of louver slat; with enclosed and protected ladders and tapes to prevent their contact with sill.

D. Tilt Control: Consisting of enclosed worm gear mechanism, slip clutch or detachable wand preventing over rotation, and linkage rod, for the following operation:
1. Tilt Operation: Manual with cord- or rod-operated tilter.
2. Length of Tilt Control: Full length of blind.
3. Tilt: Full.

E. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

F. Tilt-Control and Cord-Lock Position: Right side and left side of headrail, respectively, unless otherwise indicated.

G. Ladders: Evenly spaced to prevent long-term louver sag.
1. For Blinds with Nominal Slat Width 1 Inch or Less: Braided string.

H. Mounting: Position as indicated on Drawings. Manufacturer's standard mounting shall permit easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.
1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

I. Colors, Textures, Patterns, and Gloss: As selected by Designer from manufacturer's full range.

2.3 HORIZONTAL LOUVER BLINDS FABRICATION

A. Product Standard and Description: Comply with AWCMA Document 1029, unless otherwise indicated, for each horizontal louver blind designed to be self-leveling and consisting of louver slats, rails, ladders, tapes, lifting and tilting mechanisms, cord, cord lock, tilt control, and installation hardware.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
1. Lifting and Tilting Mechanisms: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg. F :
1. Blind Units Installed between (Inside) Jambs: Width equal to 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch, less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch, plus or minus 1/8 inch, less than head-to-sill dimension of opening in which each blind is installed.
2. Blind Units Installed on Wall Surface: Width equal to 1/2 inch per side or 1 inch total, plus or minus 1/8 inch, wider than jamb-to-jamb dimension of opening for which each blind is installed. Length as required to fully cover opening.
   a. Where multiple blinds are required to be mounted in series to cover wide openings, all blinds shall be mounted at same elevation, closely abutting each other to provide complete coverage of opening.
   b. Terminations between blinds of end-to-end installations shall be at centerlines of mullions or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Metal Finish: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HORIZONTAL LOUVER BLIND INSTALLATION

A. Install blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior louver edges in any position are not closer than 1 inch to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware, if any.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean blind 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 horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged blinds that cannot be repaired, in a manner approved by Designer, before time of Substantial Completion.

END OF SECTION 12491

SECTION 12660 - TELESCOPING STANDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wall-attached telescoping stands.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Decking: 3-inch- square samples of finished material.
   2. Seating: 3-inch- square sample of each seating material, color, and finish indicated.

D. Operation and Maintenance Data: For telescoping stands to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer's Engineering Responsibility: Preparation of data for telescoping stands, including Shop Drawings, and comprehensive engineering analysis by a qualified professional engineer.

C. Safety Standard: Provide telescoping stands that comply with requirements in NFPA 102.

D. Welding: Qualify procedures and personnel according to AWS D1.1 "Structural Welding Code - Steel" and AWS D1.3 "Structural Welding Code - Sheet Steel."

E. Accessibility Requirements: Provide telescoping stands that comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, and other construction that will interface with telescoping stands by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for telescoping stands is based on Maxam bleachers by Hussey Seating Company, North Berwick, ME. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
   1. Interkal LLC.
   2. Irwin Folding Bleacher Company.

2.2 MATERIALS

A. Wood:
   1. Plywood: APA grade trademarked, DOC PS 1.

B. Steel:
   1. Structural Steel Shapes, Plates, and Bars: ASTM A 36/A 36M.
   2. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
   3. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold-rolled commercial steel), or ASTM A 1011/A 1011M, Designation CS (hot-rolled commercial steel).
   4. Tubing: ASTM A 500, cold formed; ASTM A 501, hot formed; or ASTM A 513, mechanical.

C. Extruded Aluminum: ASTM B 221, alloy as standard for manufacturer.

D. Polyethylene Plastic: High-density polyethylene; molded, color-pigmented, textured, impact-resistant, structural formulation.

2.3 TELESCOPING STANDS

A. Description: Operable systems of multiple-tiered seating on interconnected folding platforms that close, without being dismantled, into a nested stack for storing against wall. Stand units permit opening and closing of adjacent rows, allow individual and collective rows to be locked open for use, and close with vertical faces of upper skirts on the same vertical plane.

B. Wall-Attached Telescoping Stands: Rear of understructure permanently attaches to wall construction.
   1. Basis-of-Design Product: Maxam "Flex-row" MXM 26 retractable bleacher system with "Court Side" seats by Hussey Seating Company, North Berwick, Maine.
      a. Operation: Manual operation.

C. Row Spacing: 22 inches and indicated on Drawings.

D. Row Rise: Risers shall be 9-5/8 inches.

E. Bench Seats and Skirts:
   1. Basis-of-Design Product: Hussey Seating Company's "Court Side" bench seats.
      a. Material: Molded polyethylene plastic with contour seat surface.
      b. Colors: As selected by Architect from manufacturer's standard.
   2. Bench Height: Not less than 16 inches or more than 18 inches.
   3. Bench Depth: 10 inches.

F. Deck: Plywood.
   1. Finish: Manufacturer's standard Low VOC transparent finish.

G. Risers: Steel sheet with manufacturer's standard rust-inhibiting coating or hot-dip galvanized finish.

H. Rails: Structural steel pipe, finished with manufacturer's standard powder coat system.
   1. Color: As selected by Architect from manufacturer's standard.

I. Understructure: Structural steel.
   1. Finish: Manufacturer's standard rust-inhibiting finish.
   2. Color: Manufacturer's standard.

J. Aisle and End Closures: Manufacturer's standard heavy-duty, vinyl coated fabric curtains that produce flush vertical face at aisles when system is stored and open ends of stands which are exposed-to-view when open, preventing climbing and ball stoppage or access to understructure, respectively.

K. Fasteners: Vibration proof, in manufacturer's standard size and material.

L. Accessories:
   1. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
   2. Gap fillers for closing openings between stand units or between stand units and adjoining construction.

2.4 FABRICATION

A. Fabricate understructure from structural steel members in size, spacing, and form required to support design loads specified in referenced safety standard.

B. Weld understructure to comply with applicable AWS standards.

C. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.

D. Form exposed sheet metal with flat, flush surfaces, level and true in line, and without cracking and grain separation.

E. Seating Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair the usefulness of seating units.
   1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where telescoping stands are to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install telescoping stands to comply with referenced safety standard and manufacturer's written instructions.

3.3 ADJUSTING AND CLEANING

A. On completion of installation, lubricate, test, and adjust each telescoping stand unit so that it operates according to manufacturer's written operating instructions.

B. Clean installed telescoping stands on exposed and semi exposed surfaces. Touch up shop-applied finishes or replace components as required to restore damaged or soiled areas.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain telescoping stands. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 12660

SECTION 13916 - FIRE-SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This work is covered under the base bid and under Bid Alternate No. 5. Refer to Division 1 and Sheet FP-100.

B. This Section includes fire-suppression sprinklers, piping, and equipment.

C. An existing sprinkler entrance is located at the Public Library entrance. The existing system serves only areas shown on the drawings and Boiler room mezzanine.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. The fire protection system shall be an automatic sprinkler system arranged to properly protect spaces as indicated.

B. Design sprinklers and obtain approval from authorities having jurisdiction. The design of the automatic sprinkler system shall be complete with all necessary accessories for proper operation.

C. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any authority having jurisdiction.

D. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
   1. Include 10 percent margin of safety for available water flow and pressure.
   2. Include losses through water-service piping, valves, and backflow preventers.

E. Sprinkler Occupancy Hazard Classifications shall be reviewed and approved by the authority with jurisdiction.

F. Minimum Density for Automatic-Sprinkler Piping Design shall be in accordance with NFPA 13. Maximum Protection Area per Sprinkler shall be in accordance with NFPA 13.

G. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

H. Protect all systems from freezing. Provide freeze protection for sprinklers in unheated areas with glycol or dry pipe system.

I. Unless approved by the State Fire Marshall, non-combustible spaces having 15 or more wires grouped together shall be fully sprinklered.

J. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

K. Coordinate Fire Department Connection type and location with local fire department.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Pipe and fitting materials and methods of joining for sprinkler piping.
2. Pipe hangers and supports.
3. Piping seismic restraints.
4. Valves, including specialty valves, accessories, and devices.
5. Alarm devices. Include electrical data.
6. Air compressor if dry system utilized.
7. Excess-pressure pumps

B. Submit working plans, prepared according to NFPA 13, and hydraulic calculations with cross reference to applicable drawings, water supply data, and equipment schedule with ratings for the system to the Owner's Representative, Insurance Underwriter, and other authorities having jurisdiction

C. Certification: Submit Contractor's NICET certification and number.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified sprinkler designer. Base calculations on results of fire hydrant flow test.

C. Sprinkler designer shall be legally qualified and licensed 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 fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.

D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

E. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. NFPA #13 Standard for the Installation of Sprinkler Systems, latest edition.

1.6 EXTRA MATERIALS

A. Furnish extra materials as required by NFPA 13.

PART 2 - PRODUCTS

2.1 PIPING

A. Pipe and fittings shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval.

B. Steel pipe from drain line valves and inspector's test valves, and where pipe is exposed to outdoor weather, etc., shall be internally and externally galvanized. Galvanized fittings are required where galvanized piping is used.

C. Pipe hangers and hanger assemblies shall be UL listed or FM approved.

2.2 JOINING MATERIALS

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.

B. Furnish in accordance with NFPA 13.

2.3 SPRINKLERS

A. Fire sprinklers shall be of one manufacturer throughout the building. No mixing of sprinkler brands shall be permitted. Sprinklers shall be of all brass frame construction with a quick response frangible bulb type fusible element.

B. Automatic Sprinklers: With heat-responsive element complying with the following:
   1. UL 199, for applications except residential.
   2. UL 1767, for early suppression, fast-response applications.

C. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

D. Sprinkler finish shall match existing.

E. Provide quick response sprinklers.

F. Institutional Semi-Recessed or "Vandal-Resistant" sprinkler heads as required by application.

G. Sprinkler Escutcheons: Materials, types, and finishes of sprinklers. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.4 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

F. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.5 VALVES

A. Valves shall be UL listed and FMG approved

2.6 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved cast- or ductile-iron body with flanged or grooved ends.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections. Furnish as required by NFPA 13:

PART 3 - EXECUTION

3.1 PREPARATION

A. The nature of the work requires coordination with other trades. Shop fabrication shall be done at the Contractor's risk. Relocation of piping and components to avoid obstructions may be necessary. Relocation, if required, shall be done at the Contractor's expense. The installation shall be performed in a workmanlike manner as determined by the Owner's Representative and

in accordance with the Contract Documents, manufacturer's printed installation instructions, and submitted and Owner's Representative reviewed drawings.

3.2 SPRINKLER APPLICATIONS

A. General: Use sprinklers according to the following applications:
1. Rooms/spaces without Ceilings: Upright sprinklers.
2. All occupied rooms with Finished Ceilings: Recessed Pendent.
3. Provide sprinkler guards for heads in mechanical and storage spaces, less than 8 ft. above finished floor subject to mechanical damage.
4. Low ceilings (under 8 feet): Institutional recessed.
5. Wall Mounting: Sidewall sprinklers.
6. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
7. Special Applications: Use extended-coverage, flow-control, and quick-response sprinklers where indicated.
8.

B. Finishes
a. Unfinished spaces not exposed to view: rough bronze.
b. Recessed Sprinklers: White
c. Exposed sprinklers subject to corrosive atmospheres shall have a factory applied corrosion resistant coating.

3.3 SYSTEM INSTALLATIONS

A. Water supply control valves shall be electrically supervised and mechanically locked for proper position. Water flow and supervisory circuits shall be in accordance with the requirements of electrical specifications. Electric connections to sprinkler system shall be by Division 16. Furnish wiring diagrams for all equipment.

B. A sprinkler head wrench of each style and model installed shall be provided to the owner at the completion of the project. A representative sampling of each sprinkler head style and model shall be provided to the owner and housed in a sprinkler head cabinet at or near the sprinkler riser. The number of sprinkler heads provided to the owner shall be in accordance with NFPA 13.

C. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13

3.4 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of 2 X 2 acoustical panels and tiles (not required for 2 X 4.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space or glycol per NFPA 13.

C. Install sprinkler piping with drains for complete system drainage.

D. Hangers and Supports: Comply with NFPA 13 for hanger materials.

3.5 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.6 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

C. Report test results promptly and in writing to Designer and authorities having jurisdiction.

3.7 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.8 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.9 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that potable-water supplies have correct types of backflow preventers.

F. Verify that glycol system is correct percentage mixture per NFPA 13.

G. Verify that fire department connections have same type compatible with local fire department equipment.

H. Fill wet-pipe sprinkler piping with water.

I. Energize circuits to electrical equipment and devices.

J. Coordinate with fire alarm tests. Operate as required.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 13916

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Furnish all services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the drawings and/or these Specifications.

C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.

D. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of HVAC equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

1.2 SUMMARY

A. This Section includes mechanical items common to all specification sections.

1.3 RENOVATION PROJECTS

A. The Contractor shall study all drawings and specifications, visit the site, and get acquainted with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to be familiarized with the conditions and extent of the proposed work. The Contractor shall execute all alterations, additions, removals, relocations or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the drawing and specifications.

1.4 REBATE GRANTS

A. The Contractor, his Subcontractors and Suppliers shall provide to the Owner all paperwork necessary to support the Owners pursuit of incentive grants related to energy conservation. This shall include at a minimum receipts for energy efficient equipment such as: lighting, motors, variable frequency drives, etc.

1.5 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.6 SUBMITTALS

A. Provide in accordance with Division 1 of the specifications.

1.7 SUBSTITUTIONS

A. Provide in accordance with Division 1 of the specifications.

1.8 QUALITY ASSURANCE

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.

B. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If

minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

F. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.

G. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber.

H. Electrical work shall be performed by, or under, the direct supervision of a licensed electrician.

1.9 DELIVERY, STORAGE, AND HANDLING OF PIPING

A. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.

C. Protect fittings, flanges, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.10 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8.

1.11 PROJECT CONDITIONS

A. Follow the recommended procedures of the SMACNA IAQ Guidelines for Occupied Buildings Under Construction.

B. Continuity of Services: The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to "General Conditions of the Contract for Construction" for temporary facilities for additional contract requirements. Schedules for various phases of contract work shall be coordinated with all other trades and with Owner's Representative. Provide, as part of contract, temporary mechanical and electrical connections and relocations as required to accomplish the above.

C. Existing Utilities: 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 Architect at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
2. Indicate method of providing temporary utilities.
3. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCT

2.1 PRODUCT CRITERIA

A. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.

B. Equipment Service: Products shall be supported by a service organization that maintains a complete inventory of repair parts and is located reasonably close to the site.

C. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.

D. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

E. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

F. Asbestos products or equipment or materials containing asbestos shall not be used.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 PIPE JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Mechanical Coupling Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents and exterior environment. Gasket design shall be such that the entire coupling housing is isolated from the system contents to prevent galvanic action and inhibit galvanic corrosion.

E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

F. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

H. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Solvent Cements for Joining Plastic Piping:
1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

B. (2 inches) and smaller: Threaded dielectric union, ANSI B16.39. Watts Series 3000, or approved equal.

C. (2 1/2 inches) and larger: Flange union with dielectric gasket and bolt sleeves, ANSI B16.42.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 MOTORS

A. Motor Characteristics
1. Motors 1/2 HP and Larger: Three phase.

2. Motors Smaller Than 1/2 HP: Single phase.
3. Frequency Rating: 60 Hz.
4. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
5. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.
6. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
7. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
8. Enclosure: as specified.

B. Polyphase Motors
1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium efficiency ratings shall meet or exceed the NEMA Premium qualifying efficiencies. For example, 1800-RPM ODP minimum required efficiencies are as follows:

   a. 1 HP: 85.5%
   b. 1.5 HP: 86.5%
   c. 2 HP: 86.5%
   d. 3 HP: 89.5%
   e. 5 HP: 89.5%
   f. 7.5 HP: 91.0%
   g. 10 HP: 91.7%
   h. 15 HP: 93.0%
   i. 20 HP: 93.0%
   j. 25 HP: 93.6%
3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
4. Rotor: Squirrel cage, unless otherwise indicated.
5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating, unless otherwise indicated.
7. Insulation: Class F, unless otherwise indicated.

C. Polyphase Motors With Additional Requirements
1. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer. All motors shall be "Inverter Ready" for variable torque application such as centrifugal pumps and fans and shall be labeled "Inverter Ready per NEMA STD MG1, part 31.4.4.2".
   a. Designed with critical vibration frequencies outside operating range of controller output.
   b. Temperature Rise: Matched to rating for Class B insulation.
   c. Insulation: Class H.
   d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

D. Single-Phase Motors
   1. Type: One of the following, to suit starting torque and requirements of specific motor application:
      a. Permanent-split capacitor.
      b. Split-phase start, capacitor run.
      c. Capacitor start, capacitor run.
   2. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
   3. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
   4. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION AND REMOVALS

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 COMMON REQUIREMENTS

A. Install piping, ductwork, and equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

E. Install piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install mechanical systems above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve servicing.

I. Install equipment and other components to allow right of way for piping installed at required slope.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Verify final equipment locations for roughing-in.

O. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items shall be replaced.
2. Protect all finished parts of equipment. Close duct and pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Non-pressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPE PENETRATIONS

A. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

B. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install steel pipe sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

C. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 1-1/2 inch above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

D. Sleeves are not required for core-drilled holes.

E. Escutcheons
1. Provide manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
2. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   a. New Piping:
      1) Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      2) Insulated Piping: One-piece, stamped-steel type with spring clips.
      3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   b. Existing Piping: Use the following:
      1) Chrome-Plated Piping: Split casting, cast-brass type with chrome-plated finish.
      2) Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
      3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.

3.5 FIRESTOPPING

A. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 7 for materials. Seal all penetrations through fire-or smoke-rated wall, partition, ceiling, or roof assemblies with firestopping system. Refer to Architectural plans for location of rated assemblies. Refer to Division 7 for firestopping systems.

3.6 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Provide dielectric fittings at connection between copper and ferrous metal.

3.7 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ROOFING

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

D. All field fabricated supports shall be painted black.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15050

SECTION 15060 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.
3. Division 13 Sections on fire-suppression piping for fire-suppression pipe hangers.
4. Division 15 Section "Metal Ducts" for ductwork.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Install in accordance with MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application

1.5 SUBMITTALS

A. Submit product data on all hanger and support devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

A. Steel pipe hangers and supports shall have the manufacturers name, part number, and applicable size stamped in the part itself for identification.

B. Pipe Hangers, Supports, and Components: The materials of all pipe hanging and supporting elements shall be in accordance with MSS SP-58.

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pipe Hangers and Supports:

a. B-Line Systems, Inc. (Basis of Design)
b. Carpenter & Patterson, Inc.
c. Grinnell Corp.
d. National Pipe Hanger Corp.
e. Piping Technology & Products, Inc.
f. Unistrut

2.2 HANGERS

A. Hanger "Types" listed below are from Table 1 of MSS SP-69.

B. Uninsulated pipes 2 inch and smaller:

1. Type 10: Adjustable steel swivel ring (band type) hanger, B-Line B3170.
2. Type 5: Adjustable steel swivel J-hanger, B-Line B3690.
3. Type 12: Malleable iron ring hanger, B-Line B3198R or hinged ring hanger, B3198H.
4. Type 1: Adjustable steel clevis hanger, B-Line B3100.

C. Uninsulated pipes 2-1/2 inch and larger:

1. Type I: Adjustable steel clevis hanger, B-Line B3100.
2. Type 41: Pipe roll with sockets, B-Line B3114.
3. Type 43: Adjustable steel yoke pipe roll, B-Line B3110.

D. Insulated pipe- Hot piping:

1. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1 with Type 40 (B-Line B3151) series insulation protection shield.
2. 2-1/2 inch and larger pipes:

a. Adjustable steel yoke pipe roll with pipe covering protection saddle. Type 43 with Type 39 (B-Line B3160-B3165 series) pipe covering protection saddles.
b. Pipe roll with sockets with pipe covering protection saddle, Type 41 with Type 39 (B-Line B3160-B3165 series) pipe covering protection saddles.

E. Insulated pipe- Cold or chilled water piping:

1. 5 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. Type 1 with Type 40 (B-Line B3151) series insulation protection shield.

F. Pipe Clamps

1. Type 4: When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, B-Line B3140.
2. Type 3: For insulated lines use double bolted pipe clamps, B-Line B3144.

G. Wall Supports

1. Pipes 4 inch and smaller: Type 5 J Hanger. B-Line B3690.
2. Pipes larger than 4 inch: Type 32.

H. Floor Supports

1. Hot piping under 6 inch and all cold piping: Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. Type 38 B-Line B3093 support and B3088T threaded base stand or Type 37 B3090 and B3088 unthreaded base stand. Pipe saddle shall be screwed or welded to appropriate base stand.
2. Hot piping 6 inch and larger: Adjustable Roller stand with base plate, Type 46 B-Line B3118SL.

I. Vertical Supports

1. Type 8: Steel riser clamp sized to fit outside diameter of pipe, B-Line B3373.

J. Copper Tubing Supports

1. Hangers shall be sized to fit copper tubing outside diameters.

a. Type 10: Adjustable steel swivel ring (band type) hanger, B-Line B3170CT.
b. Type 12: Malleable iron ring hanger, B-Line B3198RCT or hinged ring hanger B3198HCT.
c. Type 11: Malleable iron split-ring hanger with eye socket, B-Line B3173CT.
d. Type 1: Adjustable steel clevis hanger, B-Line B3104CT.

2. Type 8: For supporting vertical runs use epoxy painted or plastic coated riser clamps, B-Line B3373CT or B3373CTC.

3. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line B2000 series, or plastic inserted vibration isolation clamps, B-Line BVT series.

K. Plastic Pipe Supports:

1. V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, B-Line B3106 and B3106V, to form a continuous support system for plastic pipe or flexible tubing.

L. Supplementary Structural Supports

1. Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to engineer for approval. Use clamps and fittings designed for use with the strut system.

2.3 UPPER ATTACHMENTS

A. Beam Clamps

1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2. Type 23 C-Clamps shall have locknuts and cup point set screws, B-Line B351L, or B3036L.
3. Type 19 Top flange c-clamps shall be used when attaching a hanger rod to the top flange of structural shapes, B-Line B3034 or B3033.
4. Refer to manufacturer's recommendation for setscrew torque.
5. Retaining straps shall be used to maintain the clamps position on the beam where required.

2.4 VIBRATION ISOLATION AND SUPPORTS

1. For refrigeration, air conditioning, hydraulic, pneumatic, and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT series Vibraclamps, for pipe sizes use BVP series.
2. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.
3. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.
4. Vibration isolation products as manufactured by B-Line, Vibratrol systems.

2.5 ACCESSORIES

A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

B. Shields shall be 180 degree galvanized sheet metal, 12inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.

C. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

E. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications. Properties: Non-staining, non-corrosive, and nongaseous. Design Mix: 5000-psi, 28-day compressive strength.

2.6 FINISHES

A. Indoor Finishes

1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish, B-Line Dura-Green®.
3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.

B. Outdoor Finishes:

1. Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

3.2 HANGER SPACING

A. Support piping and tubing not listed below according to MSS SP-69 and manufacturer's written instructions.

B. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod sizes:

1. NPS ¾ to 1-1/4": Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
4. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
5. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
6. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
7. NPS 5: Maximum span, 16 feet; minimum rod size, 5/8 inch.

C. Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:

1. NPS ½ and 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2 to 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
7. NPS 2-1/2: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Maximum vertical steel and copper pipe attachment spacing: 10 feet.

E. Plastic Piping Hangers:

1. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
2. Hangers shall not compress, distort, cut or abrade the piping. All piping shall be supported at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal. Pipe should also be supported at all branch ends and at all changes of direction.
3. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

    a. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
    b. NPS 3: 48 inches with 1/2-inch rod.
    c. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
    d. NPS 6 and 8: 60 inches with 3/4-inch rod.
    e. NPS 10 to NPS 12: 8-feet with 7/8-inch rod.

4. Install supports for vertical PVC piping every 48 inches.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 5-feet. Install hangers for cast-iron piping with the following minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 3/8-inch rod.
2. NPS 3: 1/2-inch rod.
3. NPS 4 and NPS 5: 5/8-inch rod.
4. NPS 6: 3/4-inch rod.
5. NPS 8 to NPS 12: 7/8-inch rod.

G. Support vertical piping independently of connected horizontal piping. Support vertical pipes at base and at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

H. Place a hanger within 12 inches of each horizontal elbow.

3.3 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. The material in contact with the pipe shall be compatible with the piping material so that neither will have a deteriorating action on the other. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non-adhesive isolation tape- B-Line Iso-pipe. Galvanized felt isolators sized for copper tubing may also be used, B-Line B3195CT.

C. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

H. Install hangers to provide a minimum of 1/2-inch space between finished covering and adjacent work.

I. Do not support piping from other pipes, ductwork or other equipment that is not building structure.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.5 METAL FABRICATION

A. All attachments welded to the pipe shall be in accordance with MSS SP-58 and Pipe Fabrication Institute Standard ES-26.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.7 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15060

SECTION 15075 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Markers: Engraved, color-coded laminated plastic; attach with screws or contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2" x 1" or as applicable.

B. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using self-adhesive colored-coded dots (*Inventory Labels*), 3/4" diameter; Seton, or approved equal.
1. Red
   a. Duct Smoke detectors (SD)
   b. Fire dampers (FD)
2. Green
   a. VAV boxes (VAV- ***)
3. Blue
   a. Domestic water main shutoff valves (label HW, CW, etc.)
4. Orange
   a. Heating main shutoff valves (HWS, HWR)
5. Locate dots on the ceiling grid, adjacent to the ceiling tile that provides the best access to the valve or item that requires servicing.
6. Label with a permanent marker as indicated. Example, neatly write "SD" on a red dot, locate on ceiling grid below a *smoke detector*.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Seton Setmark, or approved equal; preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation; Full-band snap-around pipe markers extending 360 degrees around pipe at each location.
4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
5. Minimum length of color field and size of letters shall be in accordance with Uniform Plumbing Code requirements.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.
2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
   a. Pumps
   b. Compressors
   c. Chillers
   d. Coils
   e. Heat recovery units
   f. Rooftop Units
   g. Air handlers
   h. Fans
   i. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

B. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Equipment located above the ceiling that requires servicing shall be labeled on the ceiling using self-adhesive colored dots, 5/8" diameter.

1. Red

   a. Smoke detectors (SD)
   b. Fire dampers (FD)

2. Green

   a. VAV boxes (VAV- ***)

3. Blue

   a. Domestic water main shutoff valves (label HW, CW, etc.)

4. Orange

   a. Heating main shutoff valves (HWS, HWR)

5. Locate dots on the ceiling grid, adjacent to the ceiling tile that provides the best access to the valve or item that requires servicing.
6. Label with a permanent marker as indicated. Example, neatly write SD on a red dot, locate on ceiling grid below a smoke detector.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

B. Use size to ensure a tight fit.

C. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

D. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 20 feet along each run.
7. At least one per room.
8. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 15075

SECTION 15083 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Division 15 Section "Basic Mechanical Materials and Methods"
3. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.
4. Division 15 Section "Metal Ducts" for duct liner.

1.2 SUMMARY

A. This Section includes insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
2. Attachment and covering of heat trace inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties and equipment connections.
6. Application of field-applied jackets.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

C. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

C. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

D. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

E. Follow manufacturer's recommended handling practices.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with other trades for insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:

a. Certainteed
b. Knauf
c. Owens-Corning
d. John Mansville

2. Flexible Elastomeric Thermal Insulation:

a. Armstrong
b. Rubatex Corp.

2.2 PIPING INSULATION MATERIALS

A. Mineral Fiber Glass: heavy density molded one piece; maximum temperature 1000°F.

1. Thermal Conductivity (k value) of .21 at 75°F mean temperature.
2. Conforming to ASTM C 547; ASTM C 585; NFPA 90A and 90B; noncombustible.
3. ASJ/SSL Jacketing conforming to ASTM C 1136, Type I (replacing HH-B-100B); with a maximum vapor transmission rating of .02 perms.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

2.3 DUCTWORK INSULATION MATERIALS

A. Flexible Fiber Glass Blanket Duct Wrap; conforming to ASTM C 553, Type I, II or III

1. Thickness and R-value of the insulation shall be as installed. Installed thicknesses and R-values shall be based on 25% compression of the wrap.

2. The 1-1/2" labeled thickness shall have provide an installed R-Value of 4.2.
3. The duct wrap insulation shall consist of a blanket-type insulation composed of wool-type glass fibers firmly bonded with a thermosetting resin. Faced duct wrap material shall be factory-laminated to a scrim reinforced, foil-kraft (FSK) vapor retarder facing having a 2" stapling flange on one edge.
4. Duct wrap insulation shall meet the requirements of ASTM C1290; to a maximum service temperature of 250°F. Materials shall have a vapor-retarder facing with a water vapor permeance no greater 0.02 perms and meet the physical requirements of ASTM C1136, Type II.

B. Internal Duct Lining: Knauf Duct Liner E-M conforming to ASTM C 1071 Type I and NFPA 90A & 90B; Greenguard compliant.
1. 'K' ('ksi') Value: ASTM C 177, 0.24 at 75° F (0.035 at 24° C) mean temperature.
2. Noise Reduction Coefficient (NRC): ASTM C 423 Type A Mounting, 0.45 or higher for ½" product, 0.70 or higher for 1" product.
3. Maximum Air Velocity: 6000 FPM (1829 mpm) for Type I product, 5000 FPM (1524 mpm) for Type II product.

C. Through penetrations shall be firestopped using either JM Firetemp™ CI or SI firestopping products. All penetrations shall be packed with Firetemp Wrap blanket and the hole sealed with 1/2" thickness of either firestopping product.

2.4 FIELD-APPLIED JACKETS FOR PIPING

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White.

C. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, etc.
2. Adhesive: As recommended by insulation material manufacturer.

2.5 ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under his section shall include (but not be limited to):

1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes
2. Support Materials - Hanger straps, hanger rods, saddles, support rings

B. All accessory materials shall be installed in accordance with manufacturer's instructions.

C. Type 40 Pipe Insulation Protection Shields at each hanger:

1. 4" and smaller piping: 12" shield length
2. 6" and smaller pining: 18" shield length
3. 8" and larger piping: 24" shield length.

2.6 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

3.2 PREPARATION

A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Air duct coverings shall not be installed so as to conceal or prevent use of any service opening.

L. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

M. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation-to-insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

N. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

O. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

P. Maintain manufacturer's recommended temperatures and conditions for tapes, adhesives, mastics and cements.

Q. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

R. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

S. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

T. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7.
2. Patching, Filling, and Repairing. Where air ducts pass through walls, floors, or partitions required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall not exceed one-inch average clearance on all sides and shall be filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the same NFPA 251 time-temperature fire condition required for fire barrier penetration.

U. Floor Penetrations: Apply insulation continuously through floor assembly. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 PIPING MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings, valves, specialties, and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
4. Cover fittings with PVC fitting covers.
5. Apply insulation to flanges as specified for flange insulation application.
6. Use preformed PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
7. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 EXTERNAL DUCTWORK FLEXIBLE FIBER GLASS BLANKET

A. Apply insulation to ductwork as follows:

1. Install Duct Wrap to obtain specified R-value using a maximum compression of 25%. Installed R-value shall be per ASHRAE 90.1-1999 or other design criteria.
2. Firmly butt all joints.
3. The longitudinal seam of the vapor retarder must be overlapped a minimum of 2 inches.
4. Where vapor retarder performance is required, all penetrations and damage to the facing shall be repaired using pressure-sensitive foil tape, or mastic prior to system startup.
5. Pressure-sensitive foil tapes shall be a minimum 3 inches wide and shall be applied with moving pressure using a squeegee or other appropriate sealing tool.
6. Closure shall have a 25/50 Flame Spread/Smoke Developed Rating per UL 723.

7. Duct Wrap shall be additionally secured to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Care should be exercised to avoid over-compression of the insulation during installation.

3.6 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions.

B. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply PVC jacket for all exposed insulated piping in public spaces and occupied rooms, and all NEW insulated piping in Mechanical Rooms within 6'-"0 above finished floors. Jacket shall have 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. All cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. In hot piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 2 inches of un-insulated items.

3.9 PIPING INSULATION APPLICATION SCHEDULE

A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. For piping systems not indicated, insulate to with a similar thickness and type as those specified.

B. Piping in where subject to freezing (Examples: wall chases, exterior walls, spaces, overhangs, attics, exterior, etc): Insulate pipe with **double** the thickness called for. Pack chase with loose glass fiber insulation.

C. Insulation thicknesses and installations shall meet or exceed the requirements of ASHRAE Standard 90.1-2004.

D. Provide PVC jackets in the following locations:

1. (New) exposed piping in all occupied areas and mechanical rooms as describe previously.

E. Service: Domestic hot and recirculated hot water.

1. Operating Temperature: 60 to 140 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Pipe 1-1/4" and less: 0.5".
   b. Pipe 1-1/2" and larger: 1".

4. Vapor Retarder Required: No.
5. Finish: None.

F. Service: Domestic cold water.

1. Operating Temperature: 35 to 60 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Pipe 1-1/4" and less: 0.5".
   b. Pipe 1-1/2" and larger: 1".

4. Vapor Retarder Required: Yes.
5. Finish: None.
6. NOTE: Insulate all new cold water and new chiller makeup water piping.

G. Service: Horizontal and Exposed Vertical Rainwater conductors.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: All pipe sizes: 1".
4. Vapor Retarder Required: Yes.
5. Finish: None.

H. Service: Roof drain bodies.

1. Operating Temperature: 32 to 100 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: ½".
4. Vapor Retarder Required: Yes.
5. Finish: None.

I. Service: Chilled-water (40F to 60F temperature range) supply and return.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Pipe 1-1/4" and less: 1/2".
   b. Pipe 1-1/2" and larger: 1".

4. Vapor Retarder Required: Yes.
5. Finish: None.

J. Service: Refrigerant suction and liquid piping.

1. Operating Temperature: 35 to 60 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: 1".
4. Vapor Retarder Required: No.
5. Finish: None.

K. Service: (Heating hot-water) supply and return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Pipe 3" and less: 1".
   b. Pipe 4" and larger: 1.5".

4. Vapor Retarder Required: No.
5. Finish: None.
6. NOTE: Insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 ft of the coil and the pipe size is 1 in or less.

3.10 EQUIPMENT INSULATION

A. For equipment not indicated, insulate to with a similar thickness and type as those specified.

B. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, converters and heat exchangers, which must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage.

C. Omit insulation from the following, except for cold surfaces, which shall be provided with removable covers:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

D. Filter assembly housings and sound attenuators when factory un-insulated: 1" rigid fiberglass.

E. Cold-surface equipment insulation: insulate all equipment to prevent any sweating.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Thickness: 3/4".
3. Insulation Material: Flexible elastomeric.
4. Vapor Retarder Required: Yes.
5. Finish: None.
6. Items that require servicing: Arrange for easy removal.

3.11 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section. For duct systems not indicated, insulate to with a similar thickness and type as those specified.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Internally insulated ductwork and air handling units. Omit insulation on relief air ducts (Economizer cycle exhaust air).
2. Exhaust air ducts and plenums, and ventilation exhaust airshafts within the conditioned building.
3. Metal ducts with duct liner.
4. Factory-insulated flexible ducts.
5. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
6. Flexible connectors.
7. Vibration-control devices.
8. Testing agency labels and stamps.
9. Nameplates and data plates.
10. Access panels and doors in air-distribution systems.

3.12 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Supply-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

B. Service: Supply-air ducts, exposed to condition space: No insulation required.

C. Service: Return-air ducts within heated building envelope: No insulation required.

D. Service: Concealed return air duct above ceilings at a roof level and in chases with external wall:

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.

3. Number of Layers: One.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

E. Service: Exhaust-air ducts, in cold, unconditioned space.

1. Material: Mineral-fiber blanket.
2. R-value: R6 minimum.
3. Number of Layers: One or two as required.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

F. Service: Outside-air ducts, concealed.

1. Material: Mineral-fiber blanket.
2. R-value: R6 minimum.
3. Number of Layers: One.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

G. Service: Outside-air ducts and plenums, exposed.

1. Material: Mineral-fiber board.
2. R-value: R6 minimum.
3. Number of Layers: One.
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: Yes.

END OF SECTION 15083

SECTION 15121 - PIPE EXPANSION FITTINGS AND LOOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This Section includes pipe expansion fittings and loops for mechanical piping systems, and the following:
   1. Braided Expansion Loops
   2. Flexible-hose expansion joints.
   3. Guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

1.4 SUBMITTALS

A. Product Data: For each type of expansion fitting indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

   1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
   2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
   3. Alignment Guide Details: Detail field assembly and anchorage.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

1.5 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexible-Hose and Braided Expansion Joints:

   a. Flexicraft Industries.
   b. Metraflex Co.

2. Guides:
   a. B-Line Systems, Inc.
   b. Grinnell Corp.
   c. Hyspan Precision Products, Inc.
   d. Metraflex Co.

2.2 BRAIDED EXPANSION LOOPS

A. Provide flexible expansion loops of size and type noted on drawings; Metraflex Metraloop expansion joints, or approved equal. Flexible loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug.

B. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application.

C. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.

D. Size for 4" end-to-end movement.

2.3 GUIDES

A. Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION FITTING INSTALLATION

A. Install expansion fittings according to manufacturer's written instructions.

B. Install expansion fittings in sizes matching pipe size in which they are installed.

C. Align expansion fittings to avoid end-loading and torsional stress.

3.2 GUIDE INSTALLATION

A. Install guides on piping adjoining expansion fittings and loops.

B. Attach guides to pipe and secure to building structure.

3.3 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.

END OF SECTION 15121

SECTION 15122 - METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment.

1.2 SUMMARY

A. This Section includes meters and gages for mechanical systems and water meters installed outside the building.

B. Utility-Furnished Products: Water meters will be furnished to site, ready for installation.

1.3 SUBMITTALS

A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.

B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.

C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

D. Maintenance Data: For meters and gages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Liquid-in-Glass Thermometers:

a. Ashcroft

b. Ernst Gage Co.
c. Trerice: H. O. Trerice Co.
d. Weiss Instruments, Inc.

2. Pressure Gages:

a. AMETEK, Inc.; U.S. Gauge Div.
b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
d. Ernst Gage Co.
e. Marsh Bellofram.
f. Noshok, Inc.
g. Trerice: H. O. Trerice Co.
h. Weiss Instruments, Inc.

3. Test Plugs:

a. Flow Design, Inc.
b. MG Piping Products Co.
c. National Meter.
d. Peterson Equipment Co., Inc.
e. Sisco Manufacturing Co.
f. Trerice: H. O. Trerice Co.
g. Watts Industries, Inc.; Water Products Div.

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:

1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Hot Water: 30 to 300 deg F, with 2-degree scale divisions.
4. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Description: ASTM E 1.

B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9-inches long.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.

E. Scale: Satin-faced non-reflective aluminum with permanently etched markings.

F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

2.4 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.5 THERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Material: Steel, for use in steel piping.
4. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
5. Insertion Length: To extend to center of pipe.
6. Cap: Threaded, with chain permanently fastened to socket.
7. Heat-Transfer Fluid: Oil or graphite.

2.6 PRESSURE GAGES

A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.

C. Connector: Brass, NPS 1/4.

D. Scale: White-coated aluminum with permanently etched markings.

E. Accuracy: Grade B, plus or minus 2 percent of middle 50 percent of scale.

F. Range: Comply with the following:

1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure.
2. Fluids under Pressure: Two times the operating pressure.

2.7 PRESSURE-GAGE FITTINGS

A. Install pressure-gage needle valve and snubber in piping to pressure gages.

B. Valves: NPS 1/4 brass or stainless steel needle type.

C. Siphons: NPS 1/4 coil of brass tubing with threaded ends.

D. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.8 TEST PLUGS

A. Description: Nickel-plated, brass-body test plug in NPS 1/2 fitting.

B. Body: Length as required to extend beyond insulation.

C. Pressure Rating: 500 psig minimum.

D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.

E. Core Material for Air, Water, Oil, and Gas: 20 to 200 deg F, chlorosulfonated polyethylene synthetic rubber.

F. Core Material for Air and Water: Minus 30 to plus 275 deg F, ethylene-propylene-diene terpolymer rubber.

G. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

H. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.

1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.1 METER AND GAGE INSTALLATION, GENERAL

A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

A. Install thermometers and adjust vertical and tilted positions.

B. Install in locations as shown on the plans.

C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.

3.3 PRESSURE-GAGE INSTALLATION

A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.

B. Install pressure gages in the locations shown on the plans.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

3.5 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 15122

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
3. Division 15 Section "Hangers and Supports"
4. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.

1.2 SUMMARY

A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

B. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Distribution Piping: 125 psig.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in "Cleaning" Article in Part 3.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with Maine State Internal Plumbing Code, which is based on the 2000 edition of the Uniform Plumbing Code.

C. Qualify soldering processes, procedures, and solderers for copper and copper alloy pipe and tube in accordance with ASTM B 828.

D. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.

E. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," and NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for combined fire-protection and domestic water service piping to building.

F. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 COPPER TUBING

A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

    a. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

C. Mechanically formed copper or steel tee connections are not acceptable.

2.3 VALVES

A. Ball Valves

1. Threaded Ends 4" and Smaller: 600# W.O.G., cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Hammond 8501, Nibco T-585-70, Milwaukee BA100, Apollo 70-Series, or approved equal.
2. Soldered Ends 3" and Smaller: 600# W.O.G., cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Hammond 8511, Nibco S-585-70, Milwaukee BA150, Apollo 70-Series, approved or equal.
3. Comply with MSS SP-110.

B. Wafer Check valves:

1. Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between 2 standard Class 125 flanges. Construct iron body valves with pressure containing parts of valves with materials conforming to ANSI/ASTM A 126, Grade B. Support hanger pin by removable side plug.
2. 2" and Larger: Class 125, cast iron body, stainless steel trim, bronze disc, Buna-N seal: Nibco W920-W, Stockham WG970, Metraflex C-125, Hammond 9253, Milwaukee 1400, or approved equal.

C. Swing check valves:

1. Construct pressure containing parts of Valves as follows:

   a. Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62
   b. Iron Body Valves: ANSI/ASTM A-126, Grade B

2. Comply with the following standards for design, workmanship, material and testing:

   a. Bronze Valves: MSS SP - 80
   b. Cast Iron Valves: MSS SP – 71

3. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
4. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond 1B904, Nibco T-413B, Stockham B319, Milwaukee 509 or approved equal.
5. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond 1B912, Nibco S-413-B, Stockham B309, Milwaukee 1509 or approved equal.

D. Refer to Division 15 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Mechanically formed tee-branch outlets and brazed joints shall not be used.

C. Underground Domestic Water Piping NPS 4 and Smaller: Soft copper tube, Type L; copper pressure fittings; and soldered joints.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated, memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

3.3 PIPING INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install underground copper tubing according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 15 Section "Meters and Gages" for pressure gages, and to Division 15 Section "Plumbing Specialties" for drain valves and strainers.

D. Install aboveground domestic water piping level and plumb.

E. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

F. Perform the following steps before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

G. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

H. Energize pumps and verify proper operation.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 and smaller.

C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

3.6 HANGER AND SUPPORT INSTALLATION

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports."

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."

2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 ADJUSTING

A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
2. Adjust calibrated balancing valves to flows indicated.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping per code requirements or administrative authority requirements. Sample procedure as indicated:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 15140

SECTION 15150 – PLUMBING SANITARY AND STORM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.2 SUMMARY

A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.

B. This Section includes storm-drainage piping inside the building and to locations indicated.

C. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.

1.3 PERFORMANCE REQUIREMENTS

A. Comply with the municipal requirements for the connection of sanitary sewer and storm lines to the municipal utility services. Obtain and pay for all necessary permits from the applicable municipal department. Obtain authority to connect to their existing mains.

B. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: per local plumbing code.
2. Sanitary Sewer, Force-Main Piping: per local plumbing code.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with Maine State Internal Plumbing Code, which is based on the 2000 edition of the Uniform Plumbing Code.

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 CAST-IRON SOIL PIPING

A. Hub-and-Spigot Pipe and Fittings: ASTM A 74, Service Extra-Heavy class. Gaskets: ASTM C 564, rubber.

B. Hubless Pipe and Fittings: ASTM A 888 or CISPI 301. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.

2.3 PVC PIPING

A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.

2.4 FIRESTOP PROTECTION FOR DWV AND STORMWATER PIPING

A. All piping penetrations of fire-resistant rated construction shall be protected in accordance with the plumbing code.

B. Use ProSet, or approved equal, "Firestop Penetrators", Warnock Hersey classified and listed in the building materials directory.

C. Products shall be tested in accordance with the ASTM E-814 standards and shall be selected for all applicable pipe penetrations and plumbing fixture floor openings through Fire-Rated floors, walls or floor/ceiling assemblies, in accordance with the Manufacturer's instructions.

1. Use ProSet System "B" Penetrators for cast iron DWV pipes for stacks and drains penetrating floors and walls.
2. Use ProSet System "C" Penetrators for plastic DWV pipes for stacks and drains penetrating floors and walls

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:

1. Cast iron
2. Schedule 40 PVC

D. Vent Piping through roof/exposed above roof: Use any of the following piping materials for each size range:

1. Cast iron
2. Schedule 40 PVC

E. Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:

1. Cast iron
2. Schedule 40 PVC

F. Aboveground Storm Drain Piping:

1. Cast iron
2. Schedule 40 PVC

G. Underground Storm Drain Piping:

1. Cast iron
2. Schedule 40 PVC

3.2 PIPING INSTALLATION

A. Refer to Division 2 for Project-site sanitary sewer piping.

B. Refer to Division 2 Project site storm sewer and drainage piping.

C. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

D. Install cleanouts at grade and extend to where building drains connect to site piping.

E. Install cleanout fitting with closure plug inside the building in force-main piping.

F. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install drainage and vent piping at the minimum slopes as required by the local plumbing code.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

A. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Use gate or full-port ball valve for piping NPS 2 and smaller.
2. Use gate valve for piping NPS 2-1/2 and larger.

B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports."

B. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

E. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

E. Prepare reports for tests and required corrective action.

F. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-

stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15150

SECTION 15181 – HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 7 Section for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 15 Section "Basic Mechanical Materials and Methods"
3. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements.
4. Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
5. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
6. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
7. Division 15 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.2 SUMMARY

A. This Section includes piping, special-duty valves, and specialties for

1. Hot water heating
2. Chilled water
3. Makeup water for HVAC systems

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard submittal cut sheets. For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.

B. Shop Drawings: Detail fabrication of pipe anchors, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.

F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.4 QUALITY ASSURANCE – COOLING SYSTEMS PIPING

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Qualify soldering processes, procedures, and solderers for copper and copper alloy pipe and tube in accordance with ASTM B 828.

C. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.

B. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C. Coordinate pipe sleeve installations for foundation wall penetrations.

D. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

E. Coordinate pipe fitting pressure classes with products specified in related Sections.

F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

G. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:

   a. Victaulic Company of America.
   b. Central Sprinkler Company; Central Grooved Piping Products.
   c. Grinnell Corporation.

2. Hydronic Calibrated Balancing Valves:

   a. Griswold Controls.
   b. ITT Bell & Gossett; ITT Fluid Technology Corp.
   c. Taco, Inc.
   d. Tour & Anderson

3. Safety Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Conbraco Industries, Inc.
   d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   e. Kunkle Valve Division.
   f. Spence Engineering Company, Inc.

4. Automatic Flow-Control Valves:

   a. Flow Design, Inc.
   b. Griswold Controls.

5. Expansion Tanks, Air Separators, and Hydronic Specialties:

   a. Amtrol, Inc.
   b. Woods
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Taco, Inc.
   e. Aurora

6. Air Vents and Vacuum Breakers:

   a. Armstrong International, Inc.
   b. Barnes & Jones, Inc.
   c. ITT Hoffman; ITT Fluid Technology Corp.
   d. Johnson Corp. (The).
   e. Spirax Sarco, Inc.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

E. Wrought-Copper Unions: ASME B16.22.

F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40 and 80, black steel, plain ends.

B. Steel Pipe, NPS 2-1/2 and larger: ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40 and 80, black steel, plain ends.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt-welding.
3. Facings: Raised face.

I. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 210 °F in lieu of welded, screwed or flanged connections.

1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

J. Mechanically formed copper or steel tee connections are not acceptable.

K. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and thredolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.

L. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

M. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 PLASTIC PIPE AND FITTINGS

A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends.

B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

1. PVC Solvent Cement: ASTM D 2564.

2.6 HYDRONIC VALVES

A. Gate Valves

1. Threaded Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising stem, solid wedge: Hammond IB617, Nibco T-124/134, Stockham B105, Milwaukee 1152 or equal.
2. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge: Hammond IR1140, Nibco F617-0, Stockham G623, Milwaukee F2885 or equal.
3. Solder Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising stem, solid wedge: Hammond IB648, Nibco S134, Stockham B115, Milwaukee 1169 or equal.
4. Comply with the following standards:

   a. Cast Iron Valves: MSS SP – 70
   b. Bronze Valves: MSS SP - 80

B. Ball Valves

1. Threaded Ends 4" and Smaller: 600# W.O.G., cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Hammond 8501, Nibco T-585-70, Milwaukee BA100, Apollo 70-Series, or approved equal.
2. Soldered Ends 3" and Smaller: 600# W.O.G., cast bronze two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Hammond 8511, Nibco S-585-70, Milwaukee BA150, Apollo 70-Series, approved or equal.
3. Comply with MSS SP-110.

C. Swing check valves:

1. Construct pressure containing parts of Valves as follows:

   a. Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62
   b. Iron Body Valves: ANSI/ASTM A-126, Grade B

2. Comply with the following standards for design, workmanship, material and testing:

   a. Bronze Valves: MSS SP - 80
   b. Cast Iron Valves: MSS SP – 71

3. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
4. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB904, Nibco T-413Y, Stockham B320T, Milwaukee 509 or approved equal.
5. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB912, Nibco S-413-Y, Stockham B310T, Milwaukee 511 or approved equal.
6. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Hammond IR1124, Nibco F918-B, Stockham G931, Milwaukee F2974 or approved equal.

D. Check valves at pump discharges shall be non-slam wafer type, and should be 6 to 8 pipe diameters downstream from the pump discharge and any other fittings.

E. "Circuit setter" calibrated balancing valves, NPS 2-1/2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

1. Provide a closed cell polyethylene foam insulation kit with each valve.

F. Calibrated Balancing Valves, NPS 3 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

G. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

H. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:

1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel piston and spring.
2. Brass or ferrous-metal body, designed for 300 psig at 250 deg F with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig at 250 deg F.

2.7 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

D. Air and Dirt Separator: Furnish and install air and dirt removal devices of the size and type as shown on the plans. Air and dirt separation devices shall be Taco model 4900 series or approved equal. Air and dirt removal device shall be constructed of steel designed and fabricated per ASME Section VIII Division 1 with a maximum working pressure rating of 125 psi at 270°F. Units up to 3-inch in size shall be provided with flanged system connections. Units 4-inch and larger shall be provided with flanged system connections as standard. Each air and dirt separator shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and the removal of floating impurities from the air system interface within the separator. A blowdown valve shall be provided by the unit manufacturer on the bottom of each air/dirt separator to allow cleaning as required. The air and dirt separator shall employ the use of high surface pall rings to achieve optimal separation of gas and dirt.

E. Pump Suction Diffuser: An angle-pattern flow straightening fitting that combines a diffuser strainer orifice cylinder and full-length straightening vanes to provide ideal flow conditions for the pump suction. Taco SD Series, or approved equal. Provide 125 psi ANSI flanges, tapped

suction gauge port, adjustable foot support, bronze start-up strainer, and stainless steel permanent strainer.

F. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

G. Flexible Connectors: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

PART 3 - EXECUTION

3.1 HYDRONIC PIPING APPLICATIONS

A. Hot and Chilled Water, NPS 2 and Smaller: Aboveground, use Type L drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints. Belowground or within slabs, use Type K annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within floor slabs.

B. Hot and Chilled Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.

C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints or Schedule 40, PVC pipe with solvent-welded joints..

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chain-wheel operators on valves NPS 4 and larger and more than 96 inchesabove floor. Extend chains to 74 inches above finished floor elevation.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 VALVE APPLICATIONS

A. Hydronic Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Gate, ball, and butterfly valves.
2. Throttling Duty: Globe, ball, and butterfly valves.

B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

3.4 HYDRONIC PIPING INSTALLATIONS

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and hose-end fitting with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Pipe size at connections to equipment shall be distribution main size, not connection size.

F. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

G. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

H. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blow-down connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.

I. Anchor piping for proper direction of expansion and contraction.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports."

B. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.

3.6 PIPE JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install separator in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blow-down piping with gate valve; extend to nearest drain.

C. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.8 CONTROL VALVE INSTALLATION

A. Perform the following as directed by the controls contractor:
   1. Install modulating control valves with minimum of 10 pipe diameters straight pipe at inlet and 5 pipe diameters straight pipe at outlet.
   2. Installation of immersion wells and pressure tappings, along with associated shut-off cocks.
   3. Installation of flow switches.
   4. Setting of automatic control valves or other control devices.

B. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.

C. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

D. Valves shall be installed in accordance with the manufacturer's recommendations.

E. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be services and removed without interference from structure or other pipes and/or equipment.

F. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

3.9 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Arrange piping with offsets to allow for expansion, as well as terminal unit removal.

3.10 FIELD QUALITY CONTROL

A. Prepare piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, un-insulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
4. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
5. Prepare written report of testing.

C. Check expansion tanks to determine that they are not air bound and that system is full of water.

3.11 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating and bleed air completely.
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Lubricate motors and bearings.

C. Mark calibrated nameplates of pump discharge valves after steam and condensate system balancing has been completed, to permanently indicate final balanced position.

3.12 CLEANING

A. Flush piping systems with clean water.

B. Remove and clean or replace strainer screens.

C. After cleaning and flushing hydronic-piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers, and replace with the permanent stainless steel screens.

END OF SECTION 15181

SECTION 15183 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 7 for roof curbs, piping supports, and roof penetration boots.
2. Division 7 for materials and methods for sealing pipe penetrations through fire and smoke barriers.
3. Division 7 for materials and methods for sealing pipe penetrations through exterior walls.
4. Division 15 Section "Basic Mechanical Materials and Methods"
5. Division 15 Section "Hangers and Supports" for pipe supports and installation requirements.
6. Division 15 Section "Mechanical Identification" for labeling and identifying refrigerant piping.
7. Division 15 Section "Meters and Gages" for thermometers and pressure gages.
8. Division 15 Section "HVAC Instrumentation and Controls" for thermostats, controllers, automatic-control valves, and sensors.

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. This Section includes refrigerant piping used for air-conditioning applications.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Non-electrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.

B. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C. Coordinate pipe sleeve installations for foundation wall penetrations.

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.

E. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 for materials and methods for sealing pipe penetrations through fire and smoke barriers.

F. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Refrigerants:

   a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
   b. DuPont Company; Fluorochemicals Div.
   c. Elf Atochem North America, Inc.; Fluorocarbon Div.
   d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.

2. Refrigerant Valves and Specialties:

   a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.

b. Danfoss Electronics, Inc.
c. Emerson Electric Company; Alco Controls Div.
d. Henry Valve Company.
e. Sporlan Valve Company.

2.2 COPPER TUBE AND FITTINGS

A. Seamless Copper Tube: ASTM B 280-Type ACR; ASTM B 88-Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Bronze Filler Metals: AWS A5.8, Classification BAg-1 (silver)

2.3 VALVES

A. Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

B. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

C. Check Valves Smaller Than NPS 1: 400-psig operating pressure and 285 deg F operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with solder-end connections.

D. Check Valves, NPS 1 and Larger: 400-psig operating pressure and 285 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

E. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

F. Solenoid Valves: Comply with ARI 760; 250 deg F temperature rating and 400-psig working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch conduit adapter and **[24] [120]**-V, normally **[closed] [open]** holding coil.

G. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

H. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections;

with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.4 REFRIGERANT PIPING SPECIALITIES

A. Straight- or Angle-Type Strainers: 500-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches, 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.

B. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

C. Replaceable-Core Filter-Dryers: 500-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:

1. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.
2. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.
3. Wax Removal Cartridge: Molded, bonded core of activated charcoal and desiccant with integral gaskets.

D. Permanent Filter-Dryer: 350-psig maximum operating pressure and 225 deg F maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

E. Mufflers: 500-psig operating pressure, welded-steel construction with fusible plug; sized for refrigeration capacity.

2.5 REFRIGERANTS

A. ASHRAE 34, R-134a

B. ASHRAE 34, R-22

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, within Building: Type ACR drawn-copper tubing or Type L drawn-copper tubing.

3.2 VALVE APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor, for gage taps at hot-gas bypass regulators, on each side of strainers.

B. Install check valves in compressor discharge lines and in condenser liquid lines on multiple condenser systems.

C. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.

D. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

E. Install a full-sized, three-valve bypass around each dryer.

F. Install thermostatic expansion valves as close as possible to evaporator.

1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

G. Install pressure regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

3.3 SPECIALTY APPLICATIONS

A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.

B. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

C. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.

D. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

E. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.

F. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

G. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

H. Install receivers, sized to accommodate pump-down charge, on systems 5 tons and larger and on systems with long piping runs.

I. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.4 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

G. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

H. Install bypass around moisture-liquid indicators in lines larger than NPS 2.

I. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.

J. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports."

B. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.

3.6 PIPE JOINT CONSTRUCTION

A. Braze joints according to Division 15 Section "Basic Mechanical Materials and Methods."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.7 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

    a. System shall maintain test pressure at the manifold gage throughout duration of test.
    b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Check compressor oil level above center of sight glass.
2. Open compressor suction and discharge valves.

3. Open refrigerant valves, except bypass valves that are used for other purposes.
4. Check compressor-motor alignment, and lubricate motors and bearings.

3.9 CLEANING

A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

B. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

3.10 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 15183

SECTION 15185 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Mechanical Vibration Controls and Seismic Restraints"

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. This Section includes hydronic pumps for hydronic systems.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Regulatory Requirements: Fabricate and test steam condensate pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Hydronic Pumps
1. Armstrong Pumps, Inc.
2. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
3. Taco; Fabricated Products Div.
4. PACO Pumps.

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

C. Motors Indicated to be premium effficiency: Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.

2.3 END-SUCTION PUMPS

A. Description: Taco FE, frame-mounted end-suction centrifugal, flexible-coupled, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
2. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
3. Impeller: ASTM B30-ALLOY 4A, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
4. Wear Rings: Replaceable, bronze casing ring.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
6. Seals: Self-flushing design.
7. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
8. Coupling Guard: Steel, removable, and attached to mounting frame.
9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor.

10. Motor
    a. Secured to mounting frame, with adjustable alignment.
    b. Premium Efficiency
    c. Suitable for VFD.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

B. Triple-Duty Valve: (May be substituted for check, balance, and shutoff valves shown in Pump Detail) Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill base plate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install suction diffuser and shutoff valve on suction side of base-mounted pumps.

F. Install triple-duty valve on discharge side of base-mounted pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge. Install at integral pressure-gage tappings where provided.

I. Install electrical connections for power, controls, and devices.

J. Electrical power and control wiring and connections are specified in Division 16 Sections.

3.5 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:

1. Lubricate bearings.
2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
5. Check suction piping connections for tightness to avoid drawing air into pumps.
6. Clean strainers.
7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:

1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
2. Open cooling water supply valves if stuffing boxes are water-cooled.
3. Open sealing liquid-supply valves if pumps are so fitted.
4. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
5. Open circulating line valves if pumps should not be operated against dead shutoff.
6. Start motors.
7. Open discharge valves slowly.
8. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
9. Check general mechanical operation of pumps and motors.
10. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

F. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals.

END OF SECTION 15185

SECTION 15189 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:
   1. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. This Section includes water-treatment systems for the following:
   1. Chilled-water piping (closed-loop system).

1.3 CHEMICAL FEED SYSTEM DESCRIPTION

A. Closed-Loop System: One bypass feeder on each system with isolating and drain valves downstream from circulating pumps, unless otherwise indicated.

   1. Introduce chemical treatment through bypass feeder when required or indicated by test.

1.4 PERFORMANCE REQUIREMENTS

A. Maintain water quality for HVAC systems that controls corrosion and build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.

B. Base chemical treatment performance requirements on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

   1. Closed System: Maintain system essentially free of scale, corrosion, and fouling.

1.5 SUBMITTALS

A. Product Data: Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and furnished products listed below:
   1. Chemical solution tanks.
   2. Test equipment.

3. Chemicals.
4. Chemical feeders.

B. Shop Drawings: Detail equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the chemical treatment manufacturer for both installation and maintenance of chemical treatment equipment required for this Project.

1.7 MAINTENANCE

A. Scope of Service: Provide chemicals and service program for maintaining optimum conditions in the circulating water for inhibiting corrosion, scale, and organic growths in the cooling, chilled-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, including the following:

1. Initial water analysis and recommendations.
2. Startup assistance.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical assistance.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Chemicals: Furnish quantity equal to 100% percent of amount initially installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HVAC Water-Treatment Products:
   a. Aqua-Chem, Inc.; Cleaver-Brooks Div.
   b. Barclay Chemical Co., Water Management, Inc.
   c. Calgon Corp., ECC International.
   d. DuBois Chemicals, Inc.; DuBois USA Subsidiary.
   e. Nalco Chemical Co.

2.2 CHEMICAL FEEDING EQUIPMENT

A. Bypass Feeders: Cast iron or steel, for introducing chemicals into system; with funnel shutoff valve on top, air-release valve on top, drain valve on bottom, and recirculating shutoff valves on sides.

1. Capacity: 5 gal.
2. Working Pressure: 125 psig.

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer recommended equipment and chemicals, in a carrying case, for testing pH, total dissolved solids, dissolved oxygen, biocount, chloride, and total alkalinity and for calcium hardness field tests.

2.4 CHEMICALS

A. Furnish chemicals recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment.

B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

C. Closed-Loop, Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH and corrosion inhibitors.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to maintain the water quality as specified in "Performance Requirements" Article.

3.2 INSTALLATION

A. Install treatment equipment level and plumb.

B. Add cleaning chemicals as recommended by manufacturer.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Confirm applicable electrical requirements in Division 16 Sections for connecting electrical equipment.

3.4 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

B. Test chemical feed piping as follows:

1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
6. Prepare test reports, including required corrective action.

3.5 ADJUSTING

A. Sample Chilled Water System at one-week intervals after startup for a period of five weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D 3370 and the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform two separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

B. Review manufacturer's safety data sheets for handling of chemicals.

C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout."

D. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Operation and Maintenance Data."

END OF SECTION 15189

SECTION 15410 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.2 SUMMARY

A. Plumbing Fixtures and related components.

1.3 SUBMITTALS

A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Comply with Maine State Internal Plumbing Code, which is based on the 2000 edition of the Uniform Plumbing Code.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.5 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

A. Manufacturers (the two manufacturers listed are the only acceptable manufacturers)
1. American Standard, Inc.
2. Kohler Co.

B. Wall Hung Flush Valve Water Closet **(P-1)**: American Standard Afwall Model 2257.103. Style: Flushometer valve. Bowl Type: Elongated with siphon-jet design. Design Consumption: 1.6 gal./flush. Color: White. Rim Height: Standard, rim height at 15" above floor. ADA rim height: 17" above floor.

C. ADA Floor Mount Flush Valve Water Closet **(P-1A)**: American Standard, Madera Model #2305.100 top spud. Material: Vitreous-china Style: Flushometer valve. Bowl Type: Elongated with siphon-jet design. Design Consumption: 1.6 gal./flush. Color: White. Flushometer: Type 1. Toilet Seat: Type 1. Fixture Support: None. Rim Height: Standard, rim height at 16 1/8" above floor.

D. Standard Flush Valve: Sloan Royal Model #111 – Exposed, quiet diaphragm-type, chrome-plated closet flushometer valve with a polished exterior. PERMEX synthetic rubber diaphragm with dual filtered fixed bypass. ADA compliant metal oscillating non-hold-open handle with triple seal handle packing. 1" IPS screwdriver bak-chek angle stop. Free spinning vandal resistant stop cap, adjustable tailpiece. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut. Spud coupling and flange for 1½" top spud. Sweat solder adapter with cover tube and cast set screw wall flange. High copper, low zinc brass castings for dezincification resistance. Non-hold-open handle, fixed metering bypass and no external volume adjustment to ensure water conservation. Flush accuracy controlled by CID Technology. Diaphragm, handle packing, stop seat and vacuum breaker to be molded from PERMEX rubber compound for chloramine resistance.

E. Toilet Seat Olsonite #95 – Elongated, Standard White, Open Front Toilet Seat Less Cover with Stainless Steel Check Hinge. Provide with antimicrobial protection.

F. Water-Closet Support for wall-mounted water closets: Zurn Industries, Inc. #1203 or 1204

1. Water-closet combination carrier; include single or double, vertical or horizontal, hub-and-spigot or hub-less waste fitting with vent as required for piping arrangement
2. Floor mounted foot supports
3. Fixture bolts and hardware to match fixture.
4. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

2.2 LAVATORIES

A. Manufacturers:

1. Zurn
2. American Standard
3. Kohler
4. Eljer

B. Lavatory

1. Wall-Hung Lavatory **(P-2)**: Zurn Z5344; ADA, 20" x 18" vitreous china wall hung lavatory with 4" center faucet holes; provide with hanger plate and holes for concealed arm carrier systems. Front overflow. Waste: 1-1/4" O.D. Depth 5-3/4".
2. Faucet: Chicago Faucets model 802-VXKCP Deck Mounted Fitting, 4" Integral Spout, E12VP - Vandal Resistant Softflo® Aerator, 390 - Curved Lever Handles, Ceramic Disc Operating Cartridge, Vandal Resistant Handles and Aerator, 1/2" NPSM Coupling Nuts for 3/8" or 1/2" Flexible Risers, Pressure Compensating 2.2GPM (8.3 L/min.).
3. Drain: Z8743-PC Cast Brass, solid-top, open-grid, C/O plug with 1-1/4" diameter 17-gauge tailpiece and cast brass locknut for sink depths up to 2-1/4". Offset tailpiece if required to fit within lavatory shield.
4. P-Trap: Z8701-PC: Chrome Plated, Cast Body P Trap, Tubular Wall Bend 10-1/2" CL, Die Cast Nuts, Shallow Escutcheon with 1-1/4" Compression Inlet x 1-1/2" Compression Outlet.
5. Supply Line: Z8806LRLK-PC-TMV-1: Loose Key Standard Stop Lavatory Supply Kit, Two Chrome-Plated, Solid Brass Angle Stops with Round Wheel Handles, Two 12" Flexible Chrome-Plated Lavatory Risers Complete with Two Chrome-Plated Steel Flanges. Connections 1/2" SWT x 3/8" OD.
   a. Unit shall be provided with Aqua-Guard Thermostatic mixing valve to be installed at the point of use to assist the prevention of scalding. The Zurn ZW1070 shall be ASSE 1016 listed for point of use and will mix hot and cold water from the distribution system to a final safer temperature of 95-115 degrees F.
6. Lavatory Shield: Trap Wrap: Z6900-VG ADA Rigid Lavatory Enclosure, Vandal-Gard, Molded Rigid Vinyl, Pipe-Cover Protection System. Conceals all Lavatory Piping and Mixing Valves.
7. Lavatory Support: Zurn Industries, Inc. Model #Z-1231 Series Concealed arm lavatory carrier; Rectangular steel uprights with welded feet; Cast iron adjustable header; Steel sleeves; Alignment truss; Mounting fasteners.

2.3 SINKS

A. Install check valves at HW and CW connections.

B. Classroom ADA Single Bowl Sink w/ Bubbler **(P-3)**:

1. Elkay Manufacturing Co., Model #DRKAD2522L

   a. Overall Size: 25" X 22" X 5-1/2".
   b. Single compartment, counter mounted, self-rimming
   c. Type 304 Stainless steel
   d. Underside undercoating to dampen sound and prevent condensation.
   e. Hole punchings: three holes on 4" centers to accommodate faucet, bubbler punching. Coordinate requirements.
   f. Supplies: NPS 1/2 chrome-plated copper with stops.
   g. Grid strainer drain
   h. Drain Piping: 1 1/2" inlet to 2" outlet, chrome plated trap, chrome-plated 0.045-inch- thick tubular brass waste to sediment trap
   i. 9-1/4" clear above trap for strainer removal.
   j. Offset drain as required to locate sediment trap tight to wall.
2. Sink Faucet: Chicago model 895-317RGD1CP. Deck mounted sink faucet. GNRGD1CP – rigid gooseneck spout. E3 – Softflo Aerator. 317 – Wrist blade handles. Quaturn operating cartridge.
3. Unit shall be furnished with a 0.5 GPM pressure compensating aerator (Complying with ANSI A112.18.1 Standard for flow), a brass ADA compliant lever handle, stainless steel flex connection hoses and mounting hardware.
4. No Lead Bubbler Just Manufacturing model JBB-5. Self closing lever controlled offset bubbler. Solid cast brass body. Cast brass lever arm handle. Conforms to ANSI A112.18.1. ADA Compliant. 1/2"-14 NPT male shank. Polished chrome finish..
5. Tempering Device: Lavatory and Sink Tempering Device.

C. Deep Basin Art Sink **((P-3A)**:

1. Sink: Just, Model #DLX-2133-A-GR

   a. Double compartment, 14 gauge, type 304, 18-8 stainless steel
   b. Overall Size. 21" x 33".
   c. 1¾" roll rim on 3 sides
   d. All compartment corners coved
   e. Bottom pitched to drain
   f. Bowl Size: 16" x 14" x 10 ½" flood level.
   g. Faucet: Chicago Faucets model 1100-317CP. Deck Mounted Fitting. L8 - Cast Swing Spout. E3 - Softflo® Aerator. 317 - Wrist Blade Handles. Quaturn™ Operating Cartridge. 1/2" NPSM Coupling Nuts for 3/8" or 1/2" Flexible Risers. Pressure Compensating 2.2GPM (8.3 L/min.).
   h. Supplies: NPS 1/2 chrome-plated copper with stops for faucet.
   i. Grid strainer drain.
   j. Sediment Trap: J.R. Smith, model #8710. On floor type sediment trap. White Duco coated cast iron body and aluminum gasketed cover. Removable stainless steel screens. 10-3/4"x 7-3/4" with 9-1/4" clear above trap for strainer removal.
   k. Drain Piping: Single center drain with 2" chrome-plated 0.045-inch- thick tubular brass waste to sediment trap. Offset drain as required to locate sediment trap tight to wall.
   l. Tempering Device: yes.

D. Dental Operatory Sink **(P-3B)**:

1. Sink: Elkay, Model #PSLVR-1916

a. Single compartment, seamlessly drawn of #20 gauge type 304 SS. Self-rimming.

b. Bowl depth: 6 inches.

c. Three faucet holes on 4" centers.

d. Faucet: Chicago model 895-317RGD1CP. Deck mounted sink faucet. GNRGD1CP – rigid gooseneck spout. E3 – Softflo Aerator. 317 – Wrist blade handles. Quaturn operating cartridge.

2.4 SHOWERS

A. Field-Built Shower Stall
1. Shower Surround: Field built ceramic tile surround as shown on the Architectural Plans.
2. Drain: Zurn model Z415B.

B. Hydapipe Showers Locker Room Stall Shower **(P-4)**: Symmons Hydapipe Surface Mounted Shower System, Model 1-901S or 1-903S; or approved equal; with *pressure balancing mixing valve* with screw driver service stops and adjustable stop screw to limit handle turn. Fre-flo, all brass, vandal resistant head with ball joint on institutional type head bracket. Attached soap dish and sloped metal top cap. Stainless steel covering to be 18-gauge with #4 brush finish. Through wall or through ceiling piping configuration as applicable.

a. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
b. Body Material: Cast brass.
c. Finish: Polished chrome plate.
d. Type: Single-handle pressure balance.
e. Mounting: Concealed.
f. Handle: ADA lever with adjustable stop screw to limit handle turn. Set limit to a maximum shower temperature of 110 degrees F.
g. Anti-scald Device: Integral with mixing valve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

A. Assemble and support fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

D. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

E. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

F. Install traps on fixture outlets as required.

G. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.

H. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

D. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.5 ADJUSTING

A. Operate and adjust fixtures. Replace damaged and malfunctioning fixtures.

B. Adjust water pressure to produce proper flow and stream.

C. Adjust tempering devices to a maximum outlet temperature of 110 degrees F.

D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless allowed in Division 1.

3.8 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15410

SECTION 15430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Meters and Gages"
3. Division 7 Roofing Sections for furnishing and installation of roof drains.
4. Division 2 Section "Water Distribution" for water meters outside the building.

1.2 SUMMARY

A. This Section includes plumbing specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig.
2. Sanitary Waste and Vent Piping: 10-foot head of water.
3. Storm Drainage Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

B. Field test reports.

C. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:

1.5 QUALITY ASSURANCE

A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with Maine State Internal Plumbing Code, which is based on the 2000 edition of the Uniform Plumbing Code.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance: Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Manufacturers:

1. Ames Co., Inc.
2. Cla-Val Co.
3. CMB Industries, Inc.; Febco Backflow Preventers.
4. Conbraco Industries, Inc.
5. Watts Industries, Inc.; Water Products Div.
6. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE standard, backflow preventers.

1. NPS 2 and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
3. Interior Components: Corrosion-resistant materials. AWWA C550 or FDA-approved
4. Exterior Finish: manufacturer's standard.
5. Strainer: On inlet.
6. Backflow preventers for hot water over 110F shall be a listed type for that application.

C. Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.

D. Hose-Connection Vacuum Breakers: Watts Series 8FR; ASSE 1011, nickel plated, with non-removable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

E. Double-Check Backflow Prevention Assemblies:

1. Watts Series 007 (2-1/2" and smaller)
2. Watts Series 709 (3" and larger)
3. Watts Series 709DCDA (for detector check fire service applications)

4. ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

2.2 WATER REGULATORS

A. Manufacturers:

1. Cashco, Inc.
2. Cla-Val Co.
3. Conbraco Industries, Inc.
4. FLOMATIC Corp.
5. Honeywell Braukmann.
6. IMI Cash Valve.
7. Watts Industries, Inc.; Water Products Div.
8. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.

1. NPS 2 and Smaller: Bronze body with threaded ends.

   a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
   b. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.

2. NPS 2-1/2 and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
3. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
4. Interior Components: Corrosion-resistant materials.
5. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

2.3 BALANCING VALVES

A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.

1. Manufacturers:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Flow Design, Inc.
   d. ITT Industries; Bell & Gossett Div.
   e. Taco, Inc.
   f. Tour & Andersson, Inc.
   g. Watts Industries, Inc.; Water Products Div.

2. NPS 2 and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
3. NPS 2-1/2 and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.

2.4 THERMOSTATIC WATER MIXING VALVES

A. Manufacturers:

1. Lawler Manufacturing Company, Inc.
2. Leonard Valve Company.
3. Powers
4. Symmons Industries, Inc.
5. T & S Brass and Bronze Works, Inc.

B. General: ASSE 1017 listed, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.

1. Type: Bimetal thermostat, operation and pressure rating 125 psig minimum.
2. Type: Liquid-filled motor, operation and pressure rating 100 psig minimum.

C. Thermostatic Water Mixing Valves: Unit, with the following:

1. Piping, valves, and unions. Include thermometer if not in cabinet.
2. Piping Component Finish: Polished chrome plate.
3. Cabinet: Surface-mounting stainless-steel box with stainless-steel hinged door and thermometer in front.

2.5 HYDRANTS AND HOSE BIBBS

A. Manufacturers:

1. Josam Co.
2. Simmons Manufacturing Co.
3. Smith, Jay R. Mfg. Co.
4. Watts Industries, Inc.; Drainage Products Div.
5. Woodford Manufacturing Co.
6. Zurn

B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.

1. Inlet: NPS 3/4 or NPS 1 threaded or solder joint.
2. Outlet: ASME B1.20.7, garden-hose threads.
3. Operating Keys: One with each key-operation hydrant.

C. Non-freeze Concealed-Outlet Wall Hydrants: Zurn Z1322-EZ encased Ecolotrol anti-siphon; ASSE 1019, ¾" pipe connection; automatic draining with flush-mounting box with cover, integral non-removable hose-connection backflow preventer, casing and operating rod to match

wall thickness, concealed outlet, and wall clamp. Provide nickel bronze box and hinged cover with operating key lock and "WATER" cast on cover.

2.6 TRAP SEAL PRIMER VALVES

1. Manufacturers:

   a. Precision Plumbing Products, Inc.
   b. Josam Co.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Industries, Inc.; Jonespec Div.

B. Electronic Trap Primer **(TP-A)**: PPP Inc., Model # MPB-500-115V

1. Factory assembled within a metal cabinet equipped with a subminiature solenoid valve, air gap and electronic controller, 115 volt AC.
2. Unit shall be capable of supplying up to 4 floor drains through separate priming manifolds.

2.7 WATER HAMMER ARRESTORS

A. Water Hammer Arresters: Zurn 1700 Shoktrols, comply with ASSE 1010, PDI-WH 201, and ANSI A112.26.1M; Type 304SS metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F. Maximum working pressure: 125 psi.

2.8 MISCELLANEOUS PIPING SPECIALTIES

A. Deep-Seal Traps: Zurn Z1000, Cast-iron body, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection. Provide 4-inch- minimum water seal.

B. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

C. Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.

1. Inlet: Threaded or solder joint.
2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

D. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 side drain outlet and cap.

2.9 CLEANOUTS

A. Manufacturers

1. Zurn
2. Smith, Jay R. Mfg. Co.
3. Josam Co.
4. Tyler Pipe, Wade Div.
5. Watts Industries, Inc., Drainage Products Div.

B. Cleanouts shall be gas and water-tight.

C. ZURN ZN1400-K "Level-Trol" Adjustable floor cleanout, Dura-Coated cast iron body, with gas and watertight ABS tapered thread plug, and round scoriated secured top; adjustable to finished floor. Wall cleanouts: Zurn ZN1443 with smooth access wall cover and frame.

D. Size of cleanout shall be same as pipe size through 4". Pipes 4" and larger shall have 4" cleanouts.

E. Provide outlet type as required by piping system used.

2.10 FLOOR DRAINS

A. Manufacturers

1. Zurn Industries, Inc
2. Jay R. Smith Mfg. Co.
3. Tyler Pipe, Wade Div.
4. Watts Industries, Inc

B. Floor drains shall comply with ASME A112.21.1M. Provide outlet type as required by piping system used.

C. Provide ½" trap primer connection as indicated on plans.

D. Toilet Room , Changing Room, and Shower Floor Drains: Smith #2010 Series, Zurn ZN415-6B; Dura-coated cast iron body, Flashing collar, adjustable 6" round nickel bronze top.

E. Shower Drains-Single Showers: Zurn ZN415-6B, cast iron drain and flashing collar with 6" round adjustable nickel bronze top.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

C. Install expansion joints on vertical risers, stacks, and conductors if indicated.

D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

H. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

I. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Set unit in accordance with manufacturer's recommendations. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

J. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

K. Fasten recessed-type plumbing specialties to reinforcement built into walls.

L. Install wood-blocking reinforcement for wall mounting and recessed-type plumbing specialties.

M. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations.

N. Install air vents at piping high points. Include ball valve in inlet.

O. Install traps on plumbing specialty drain outlets.

P. Water hammer arrestors shall be installed as recommended by Plumbing & Drainage Institute Standard PDI-WH-201. Locate units at the end of branch lines, between the last two fixtures served. Size units based on fixture unit total of branch. All branch pipes serving flush valve water closets shall have water hammer arrestors.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipefittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 15 Sections.

D. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing. Representative shall train Owner's maintenance personnel to adjust, operate, and maintain.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15430

SECTION 15629 - SCROLL COMPRESSOR CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. Section Includes:

1. Packaged scroll compressor – chiller (condenser-less).

1.3 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.

6. Fluid capacity of evaporator.
7. Fluid capacity of condenser.
8. Characteristics of safety relief valves.
9. Performance at varying capacity with constant design condenser-water temperature. Repeat performance at varying capacity for different condenser-water temperatures from design to minimum in 5 deg F increments.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor 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. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Source quality-control test reports.

F. Startup service reports.

G. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.
3. ASHRAE/IESNA 90.1 for energy efficiency.

D. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED SCROLL COMPRESSOR - CHILLER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Trane.
2. McQuay International.

C. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, electrical power, controls, and indicated accessories

D. General: Units ship with a full operating charge of oil. Exposed surfaces are painted with an air-dry beige primer-finish prior to shipment.

E. Trane CCAF units shall be condenserless with an optional filter-dryer and ship with a nitrogen holding charge. Units shall provide discharge line service valve, liquid line valve, moisture indicator sight-glass, thermal expansion valve, and 1/4 inch charging port at the very minimum.

F. Evaporator: Shell and tube design with seamless copper tubes roller expanded into tube sheets. Designed, tested, and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig. Water side working pressure is 300 psig. One water pass with a series of internal baffles. Each shell includes drain connections, entering and leaving temperature sensors, and 3/4-inch Armaflex II (or equal) insulation (K=0.26).

G. Starter: The unit control panel contains both a control section as well as a starter section. This panel is a painted NEMA 1 enclosure with the starter section containing the following: top access for power wiring, single point power hook-up, non-fused disconnect, 3-phase solid-state overload protection, customer wired grounding lug, and control power transformer with fused protection.

H. Compressor – Motor: Direct-drive, hermetic, 3600 rpm (60Hz), four fixed compression scroll compressors. Each compressor has: centrifugal oil pump, sump oil heater, oil level sight-glass, oil charging valve, two point lubrication for each motor bearing, flooded lubrication for the journal and thrust bearings, and an outlet check valve in the scroll discharge port. Motor is suction gas cooled, hermetically sealed, two-pole, squirrel cage induction motor.

I. Refrigerant Circuit (CC40-60T): Each refrigeration circuit (2 for specified) contains: liquid line solenoid valve, moisture indicator sight-glass, thermal expansion valve, 1/4 inch (6.35 mm) charging port, insulated suction line and discharge line service valve. Isolation valves provide means of isolating refrigerant charge in either the high or low pressure side while servicing either refrigerant circuit.

J. Warranty: A First Year Parts Warranty is included, covering the whole unit.

K. Short Circuit Rating: Offers a measure of safety for what the starter panel enclosure is able to withstand in the event of an explosion caused by a short circuit; protection is rated up to 5,000 amps.

L. Provide vibration isolators.

M. Controls:

1. Provide complete factory installed control panel (Dyna View Panel) with all select interface points of connection to the BAS for enabling unit based on OA temperature and Supply water reset.
2. Provide factory Starter control panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

D. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Division 15 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Division 15 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to chiller to allow service and maintenance.

D. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve.

E. Refrigerant Pressure Relief Valve Connections: For water chillers installed indoors, extend vent piping to the outside without valves or restrictions. Comply with ASHRAE 15.

F. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.

6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers.

END OF SECTION 15629

SECTION 15672 - AIR-COOLED CONDENSER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. This Section includes packaged, air-cooled condenser for indoor installation.

1.3 SUBMITTALS

A. Product Data: For each air-cooled condenser, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Coordination Drawings: Schematic drawing, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Liquid and vapor pipe sizes.
2. Refrigerant specialties.
3. Piping including connections, oil traps, and risers.
4. Condenser coil.

C. Manufacturer Seismic Qualification Certification: Submit certification that air-cooled condensers, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." Include the following:

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air-cooled condensers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-cooled condensers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

C. Coordinate location of refrigerant piping and electrical rough-ins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation; Carrier Air Conditioning Div.
2. McQuay International.
3. Trane Co. (The); Worldwide Applied Systems Group.

2.2 MANUFACTURED UNITS

A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.
1. See Schedule for Manufacturer and Model.

B. Condenser Coil: Seamless copper-tube, finned coil; factory tested at 425 psig.

1. Coil Fin: Aluminum.
2. Circuit: To match compressors.
3. Refrigerant Accessories: Provide receiver, pressure control, and solenoid valve for each circuit.

C. Condenser Fans and Drives: Forward-curved centrifugal fans for vertical air discharge.

1. Fan on steel shaft with self-aligning ball bearings.
2. V-belt drive with minimum of two belts; variable pitch drive pulley.
3. Motor mounted on adjustable slide base.

D. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

E. Unit Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating, designed for indoor installation, and with the following:

1. Removable panels for access to controls, condenser fans, motors, and drives.
2. Plated-steel fan guards.
3. Lifting eyes.
4. Removable legs.
5. 2-inch- thick inlet filter.

2.3 MOTORS

A. General requirements for motors are specified in Division 15 Section "Basic Mechanical".

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.
3. Motor shall be inverter duty for VFD.

2.4 FACTORY PROVIDED ACCESSORIES

A. Factory mounted fan motor VFD.

B. Head pressure controller kit to directly control the fans speed via VFD.

C. Receiver sized by Manufacturer.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate air-cooled condensers according to ARI 210/240.

B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

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 air-cooled condensers.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where air-cooled condensers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install air-cooled condensers on existing concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods". Extend as required to suit new unit.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Division 15 Section "Refrigerant Piping."

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Complete manufacturer's starting checklist.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning air-cooled condensers and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform equipment start up.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for physical damage to unit casing.
2. Verify that access doors move freely and are weathertight.
3. Clean units and inspect for construction debris.
4. Verify that all bolts and screws are tight.
5. Adjust vibration isolation and flexible connections.
6. Verify that controls are connected and operational.

C. Lubricate bearings on fans.

D. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow over coils.

G. Verify proper operation of capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-cooled condensers.

END OF SECTION 15672

SECTION 15725 - MODULAR INDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Section 15050 "Basic Mechanical Materials and Methods"
2. Division 15 Section "Humidifiers" for steam grid and evaporative humidifiers not an integral part of modular indoor air-handling units specified in this Section.

1.2 SUMMARY

A. This work is covered under Bid Alternate No. 3.

B. This Section includes constant-volume, modular air-handling units with coils for indoor installations.

1.3 SUBMITTALS

A. Product Data: For each type of modular indoor air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.

B. Field Quality-Control Test Reports: From manufacturer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain modular indoor air-handling units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of modular indoor air-handling units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NFPA Compliance: Modular indoor air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

E. ARI Certification: Modular indoor air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

F. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

G. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

H. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Units may be shipped fully assembled or disassembled to the minimum module size in accordance with shipping or jobsite requirements.

B. The units must be rigged and lifted in strict accordance with the manufacturer's recommendations.

C. All unit openings must be sealed to prevent the entrance of construction dust.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Provide structural-steel support members.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One complete set for each modular indoor air-handling unit.
2. Fan Belts: One set for each modular indoor air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane M-Series
2. Carrier 39T
3. McQuay Vision
4. York

2.2 MANUFACTURED UNITS

A. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, and accessories.

B. A galvanized steel support, minimum 10-gauge, shall be provided on the base of the unit.

2.3 CABINET

A. The unit shall be constructed as a complete frame with removable panels. Removal of side panels shall not affect the structural integrity of the unit. The casing shall be able to withstand up to 6 in. wg positive or 4 in. wg negative static pressure. All exterior wall panels shall be made of galvanized steel. Closed-cell foam gasketing shall be provided where modules join to prevent air leakage. Double-wall insulated panels shall be fabricated to allow removal for access to internal parts and components.

1. Outside Casing: G90 Galvanized steel.
2. Inside Casing: G 90 Galvanized steel, perforated as scheduled.
3. Floor Plate: Galvanized steel.

B. Cabinet Insulation: Comply with NFPA 90A. Insulation adhesive shall be UL Listed.

1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
2. Panels shall be insulated with 1-inch, 1½ -lb/ft³ or 3-lb/ft³ density insulation. Thermal resistance (R) shall be 4.17 ft²•h•°F/Btu.
3. The thermal resistance shall be at least R- 7.69.
4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
5. Location and Application: Encased between outside and inside casing.
6. Access Panels and Doors: Same materials and finishes as cabinet; complete with hinges, latches, handles, and gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections. Provide access doors as scheduled.

C. Access doors shall be constructed with a double-wall, solid, galvanized-steel interior panel and a solid, galvanized-steel exterior panel. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage. Surface-mounted handles shall be provided to allow quick access to the interior of the module and to prevent through-cabinet penetrations that could cause air leakage. Access doors shall be hinged and removable for quick, easy access.

D. Condensate Drain Pans: All coil, moisture eliminator, humidifier, and intake modules shall be provided with an insulated, double-wall, drain pan. To address indoor air quality (IAQ), the drain pan shall be sloped in two planes to eliminate stagnant water conditions and to promote positive drainage. Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at maximum-catalogued face velocity across cooling coil.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.

2.4 FAN SECTION

A. Fan-Modules: The vibration levels of the complete fan assembly shall be checked and excessive vibration including that caused by fan imbalance) shall be eliminated in the factory. Fan shaft shall be properly sized and protectively coated with lubricating oil. Fan wheels shall be keyed to fan shaft to prevent slipping. Fan shafts shall be solid and designed so that fan shaft does not pass through its first critical speed as the unit comes up to its rated rpm. Fan shafts shall not exceed 75 percent of their first critical speed at any cataloged rpm. Fan modules shall be provided with an access door on the drive side of the fan.

B. Vibration Isolation

1. Fan connections shall be isolated from unit casing by a flexible canvas duct.
2. Fan and motor assembly shall be internally isolated from the unit casing with 2-inch deflection spring isolators, furnished and installed by the unit manufacturer. The isolation system shall be designed to resist loads produced by external forces such as earthquakes and conform to the current requirements for Seismic Zone IV.

C. Forward-curved fans shall be double-width, double-inlet, multiblade type as produced by the unit manufacturer. Fan shall be forward curved (FC) as required for stable operation and optimum energy efficiency. Fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours. Fan performance shall be certified as complying with ARI Standard 430-89.

D. Backward-Inclined fans shall be double-width, double-inlet, multiblade type as produced by the unit manufacturer. Fan shall be backward inclined (BI) as required for stable operation and optimum energy efficiency. Fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours. Fan performance shall be certified as complying with ARI Standard 430-89.

E. Airfoil fans shall be double-width, double-inlet, multiblade type as produced by the unit manufacturer. Fan shall be backward-inclined airfoil (AF) as required for stable operation and optimum energy efficiency. Fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours. Fan performance shall be certified as complying with ARI Standard 430-89.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5service factor based on fan motor.

1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, non-sparking, and non-static; matched for multiple belt drives.
4. Motor shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motor shall be mounted inside the unit casing on a slide base to permit adjustment of drive belt tension.

2.5 MOTORS

A. General: Refer to Division 15 Section "Motors" for general requirements.

B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.

D. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

E. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

F. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B mounted on adjustable base.

G. Bearings: The following features are required:

1. Ball or roller bearings with inner and outer shaft seals.
2. Grease lubricated.
3. Designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motor.
4. Grease lines shall be extended to the fan support bracket on the drive side.

H. Overload Protection: Built-in, automatically resetting, thermal-overload protection.

I. Noise Rating: Quiet.

J. Efficiency: Energy-efficient motors shall have a minimum efficiency according to IEEE 112, Test Method B. Motors shall be premium efficiency.

K. Nameplate: Indicate ratings, characteristics, construction, special features, and full identification of manufacturer.

L. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.

2.6 COILS

A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Self-draining coil fabricated according to ARI 410.

1. Piping Connections: Threaded, on same end
2. Tubes: Copper.
3. Fins: Aluminum
4. Fin and Tube Joint: Mechanical bond.
5. Headers: Cast iron with drain and air vent tappings.
6. Frames: Galvanized-steel channel frame
7. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410
8. Working-Pressure Ratings: 200 psig, 325 deg F.
9. Source Quality Control: Test to 300 psig and to 200 psig underwater.

2.7 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: specified in Division 15 Section "HVAC Instrumentation and Controls."

C. A module shall be provided that supports damper assembly for outside, return and/or exhaust air.

D. Dampers shall modulate the volume of outside, return or exhaust air. Dampers shall be Ruskin CD60 type double-skin airfoil design or equivalent with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1-inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in parallel or opposed blade configuration.

E. A factory-mounted damper shall be provided in the outdoor air opening to measure airflow. Damper blades shall be galvanized steel, housed in a galvanized steel frame and mechanically fastened to a rotating axle rod. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1-inch wg. The airflow measurement station shall measure from 15 to 100 percent of total outside air and/or return air. The airflow-monitoring device shall adjust for temperature variations. The airflow monitoring output shall be a 2-10 VDC signal proportional to velocity. The accuracy of the airflow measurement station shall be ±5 percent.

F. Combination Filter and Mixing Box: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2-inch- thick, pleated, flat permanent or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.

2.8 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Filter sections shall have filter racks, an access door for filter removal and block-offs as required preventing air bypass around filters. Modules shall be supplied with 2-inch flat and cartridge filters as scheduled.

C. Pleated media filters: shall be 2-inch or 4-inch thick non-woven fabric, treated with adhesive and continuously laminated to a supported steel wire grid. Filters shall have a rated average dust spot efficiency of not less than 25 to 35 percent when tested in accordance with ASHRAE 52-76 Atmospheric dust spot method.

D. Cartridge Filters: shall be constructed by pleating a continuous sheet of fine-fiber media into closely spaced pleats with safe-edged aluminum separators. This filter shall be sealed into a metal frame assembled in a rigid manner. All cartridge filters shall be furnished with a 2-inch prefilter to provide extended cartridge life. Manufacturer shall supply side access filter rack capable of holding cartridge filters and prefilters.
   1. Efficiency of filter shall be in the range of 80 to 85 percent as determined by ASHRAE Standard 52-76.

2.9 MISCELLANEOUS MODULES

A. Access module: A module shall be provided that allows additional access/inspection for unit components and space for field installed components as needed. An access door (as scheduled) or removable panels shall be provided for easy access.

B. Turning and Discharge Plenum Modules: Plenums shall be provided to efficiently turn air and provide for sound attenuation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install per manufacturer's recommendations.

B. Concrete Bases: Refer to Section 15050, Basic Mechanical.

1. Coordinate height of concrete base to allow for proper piping connection height requirements.

C. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to modular indoor air-handling units as shown on the plans.

D. Connect condensate drain pans with full-size piping. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan per manufacturer's recommendations, and install cleanouts at changes in direction.

E. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories.

F. Electrical: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify that specified filters are installed. Check for leakage around filters. [HEPA Filter Operational Test: Pressurize housing to a minimum of 3-inch wg or to designed

operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.]

6. Verify that cooling coil drain pans have a positive slope to drain.
7. Verify that the cooling coil condensate drain trap maintains an air seal.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connection to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for modular indoor air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing modular indoor air handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units.

END OF SECTION 15725

SECTION 15732 - ROOFTOP AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section Metal Ducts
3. Division 15 Section HVAC Instrumentation and Controls

1.2 SUMMARY

A. This Section includes rooftop air conditioners, using Lennox L-Series as basis of design.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For rooftop air conditioners to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of rooftop air conditioners and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

D. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

F. ARI Certification: Units shall be ARI certified and listed.

G. Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."

H. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

1.5 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Recovery Wheel: Manufacturer's standard, but not less than five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-drive fan.
2. Filters: One set of filters for each filter bank.

PART 2 - PRODUCTS

2.1 ROOFTOP AIR CONDITIONERS

A. Manufacturers:

1. Lennox
2. Trane
3. McQuay
4. Carrier Corp.
5. York

B. Cabinet:

1. Weatherproofing tested and certified to AGA (Rain test standards) and soundproofing tested to ARI 270.
2. Cabinet shall be fully insulated; galvanized steel, and finished with electrostatically bonded powdered enamel coating to withstand 1,000-hour salt-spray test per ASTM B117.
3. Heavy gauge steel panels and full perimeter heavy gauge galvanized steel base rails.
4. Raised edges around duct and power entry openings in bottom of unit.
5. Airflow Configuration: Down-flow (vertical) return air.
6. Power Entry: Electrical lines brought through unit base or through horizontal access knockouts.
7. Exterior Panels: Constructed of heavy gauge, galvanized steel with 2-layer enamel paint finish.
8. Insulation: All panels adjacent to conditioned air fully insulated with non-hygroscopic fiberglass insulation. Unit base fully insulated.
9. Base Rail: Full perimeter base rail with rigging holes; 3 sides with fork slots.
10. Access Panels: Hinged for compressor/controls/heating areas, blower access and air filter/economizer access; and, sealed with quarter-turn latching handles and tight air and water seal.

C. Compressor: Copeland scroll type, hermetically sealed.

D. All Fans: Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drives with adjustable variable pitch motor pulley.

E. Motors: All motors shall be premium efficiency. Provide thermal overload protection.

F. Condenser Fan: Low sound operating, PVC coated fan guard, direct drive propeller type fans to discharge vertically. Condenser Fan Motor: Permanently lubricated, permanent split capacitor; totally enclosed from weather, dust and corrosion; permanently lubricated ball bearings; resiliently mounted; overload protected.

G. Evaporator Coils: Pressure and leak tested to 500-psi, nonferrous coils with enhanced aluminum fins mechanically bonded to durable copper tubes.

1. Provide a factory condensate drain trap, field install.

H. Condenser Coils: a. Pressure and leak tested to 500-psi, nonferrous coils with enhanced aluminum fins mechanically bonded to durable copper tubes.

I. Filters: To meet NFPA 90A, air filter requirements; Throwaway, 2 inch pleated MERV 7 rated.

J. Refrigeration System:

1. Self-sealing, discharge, suction and liquid line service gauge ports, freeze-stats, expansion valves and full refrigerant charge.
2. Refrigerant: R410 or R134a.
3. Compressor Circuits: Automatic reset, high pressure switch; automatic reset, low pressure switch; liquid line filter-drier.

4. Cooling system capable of operating down to 0 deg. F outdoor temperature as shipped from the factory.
5. Service Valves: Provide fully serviceable brass valves installed in discharge and liquid lines.

K. Supply Air Blower:

1. Constant air volume with adjustable pulleys.
2. Centrifugal supply air blower with permanently lubricated ball bearings and adjustable belt drive.
3. Blower assembly shall slide out of unit for servicing.
4. Blower wheel shall be statically and dynamically balanced.

L. Integrated Modular Control (IMC): Solid state control board to operate unit. Provide control of all heating, cooling and economizer functions

1. All wiring shall be color-coded and marked.
2. All control voltage shall be provided via a secondary transformer with built-in circuit breaker protection.
3. Display/Sensor Readout – Displays control parameters, diagnostic codes, and sensor readings. The IMC unit controller displays temperature and enthalpy readings from return air, supply air, and outdoor air sensors that shall be furnished with the RTU.
4. Built-in functions include:

    a. Blower on/off delay; built-in control parameter defaults,
    b. Discharge air temperature control: stage cooling, economizer, and ERS, to maintain discharge air temperature. Provide supply duct sensor. The discharge air control cooling (DACC) option automatically cycles up to 4 stages of cooling to maintain a discharge air control cooling setpoint (DACC_SP).

        1) The DACC setpoint shall be automatically reset when outdoor air temperature becomes cooler.

    c. Economizer control: Proportional control of economizer for minimum position, IAQ (demand control ventilation sequence), and free cooling.
    d. If the economizer is operating in the free cooling mode and the IAQ control requires the damper to open further, the IAQ demand will override the free cooling demand.
    e. Unit diagnosis: codes shall pinpoint problems, minimize troubleshooting time.
    f. Diagnostics code storage
    g. Low ambient controls
    h. Minimum run time
    i. Night setback mode
    j. Smoke alarm mode: unit off.
    k. Low pressure control
    l. Thermostat bounce delay
    m. 3-digit display; °F
    n. Warm-up mode.

5. Provide interface with the Maine Controls/Invensys building automation system (BAS).

   a. RTU manufacturer will provide complete unit control. Maine Controls will provide zone temperature sensing and control, bypass damper control, and CO2 analog input.
   b. Coordinate the following points:

      1) Unit start-stop
      2) Occupied/unoccupied mode signal.
      3) CO2 analog input, 0 to 10VDC – for demand control ventilation.
      4) Smoke detector input
      5) Service relay output, 24 VAC
      6) Freezestat input.

M. Cooling Controls:

1. Motorized outside, return, and energy recovery control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed. Tight-fitting parallel blade dampers with neoprene or suitable gaskets, synthetic bushings and 1% maximum leakage.
2. Damper Operation: 24 V, spring return motor with gear train sealed in oil.
3. Mixed Air Controls: Maintain 55 °F (adjustable).
4. Cooling stages as scheduled.
5. To allow blower on delay of up to 60 seconds after cooling demand is received. Default value of zero.
6. To allow blower off delay of up to 240 seconds after cooling demand has ended. Default value of zero.
7. Minimum compressor on time of 240 seconds on 3-phase units, adjustable between 60 - 510 seconds.
8. Default maximum high pressure switch trip occurrence during cooling cycle of 3. Trip occurrence limit adjustable from 1 - 8 occurrences. If maximum limit reached, compressor locked out and digital output for service activated.
9. Default maximum low pressure switch trip occurrence during cooling cycle of 3. Trip occurrence limit adjustable from 1 - 8 occurrences. If maximum limit reached, compressor locked out and digital output for service activated.
10. Low pressure trip read delay of 5 minutes if compressor off time has been less than 4 hours and outdoor temperature is less than 70 °F. Delay adjustable from 0 - 34 minutes. Temperature set point adjustable from 10 °F to 100 °F. Compressor off time adjustable from 1 - 6 hours.
11. Low pressure trip read delay of 15 minutes if compressor off time has been 4 hours or greater and outdoor temperature is less than 70 °F. Delay adjustable from 0 - 34 minutes. Temperature set point adjustable from 10 °F to 100 °F. Compressor off time adjustable from 1 - 6 hours.
12. Low pressure trip read delay of 2 minutes if compressor off time has been less than 4 hours and outdoor temperature is 70 °F or greater. Delay adjustable from 0 - 34 minutes.
13. Temperature set point adjustable from 10 °F to 100 °F.
14. Compressor off time adjustable from 1 - 6 hours.
15. Low pressure trip read delay of 8 minutes if compressor off time has been 4 hours or greater and outdoor temperature is 70 °F or greater. Delay adjustable from 0 - 34 minutes.
16. Temperature set point adjustable from 10 °F to 100 °F.
17. Compressor off time adjustable from 1 - 6 hours.

18. Each pressure switch trip occurrence (either high or low) to record error in nonvolatile memory and identify compressor circuit.
19. Low outdoor air temperature compressor lockout set point of 0°F for each compressor circuit. Low outdoor temperature-limit set point individually adjustable for each compressor circuit from 80°F to -30°F.
20. Maximum allowable evaporator freeze-stat trip occurrence of 3 during cooling demand with limit adjustable from 1 - 4 occurrences. Control to shut off compressor each time freeze-stat trip occurs and record error code in non-volatile memory. If maximum limit reached, compressor locked out and digital output for service activated.

N. Condenser Fan Control: Provide a 6 second time delay between condenser fan shutoff and restart to prevent reverse rotation of fan. Time delay adjustable between 0 - 16 seconds. First stage low outdoor temperature set point of 55 °F that reduces airflow through condenser by turning off some fans. Set point adjustable between 60 °F and 10 °F.

O. Energy Recovery System (ERS):

1. Constant volume, directly-coupled to the RTU; provide all required mounting hardware. Wheel to be located in the outside air and exhaust air streams of the unit. Unit shall be rated in accordance with ARI standard 1060-2000. Unit shall be ETL Certified per UL 1995.
2. Parallel layers of polymeric material that is physically embedded with a silica gel (desiccant). Wheels shall easily cleanable with standard coil cleaning solution. Wheel shall be segmented for easy removal.
3. Cabinet construction shall match the RTU.
4. Wheel shall pivot out of the airstream to allow the economizer to operate normally for free-cooling.
5. During economizer operation the ERS exhaust blower shall continue to run, providing power exhaust for the system. The intake blower shall be de-energized.
6. Provide:

    a. Low-voltage logic board and terminal strip.
    b. Barometric relief dampers.
    c. Motorize intake damper; open when ERS is energized, closed when de-energized.
    d. Metal-mesh, mist-eliminator-type filters in an air intake hood.
    e. Separate fused power supply.
    f. Provide low ambient frost-control kit. Unit shall operate down to 10°F without defrost at indoor RH up to 40%.
    g. ERS Support base.

P. Roof Mounting Curb: Roof mounting curb shall be fourteen gauge zinc coated steel with nominal two-inch by four-inch nailer setup. Supply/return air opening gasketing shall be provided. Curb shall ship knocked down for easy assembly. Channel shall be provided to allow for adjustment of return air opening location. Curb shall be manufactured to National Roofing Contractors Association guidelines.

Q. Generic Building Automation System (GBAS) Module — Provided for those cases where the customer uses a non-Tracer building management systems. The GBAS module provides a binary input for Demand Limiting, four (4) analog inputs for setpoint adjustment and five (5) relay outputs for diagnostic reporting. Inputs can use a potentiometer or 0-5 vdc signal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances.

B. Curb Support: Install roof curb on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure rooftop air conditioners on curbs and coordinate roof penetrations and flashing with roof construction.

C. Run drain line from cooling coil condensation drain pan to discharge

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination in roof curb.
2. Remove roof decking only as required for passage of ducts. .
3. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.

C. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping, controls, and electrical connections. Report results in writing.

B. Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

C. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

D. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Verify that specified filters are installed. Check for leakage around filters.

G. Verify that cooling coil drain pans have a positive slope to drain.

H. Verify that the cooling coil condensate drain trap maintains an air seal.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service. Perform rooftop air handling unit verification in accordance with manufacturer's recommendations.

B. Settings:

1. Set outside air and return air dampers for minimum outside air.
2. Set outside air and return air dampers for percentage of outside air required by design and repeat measurements of fan capacity.

C. Simulations: Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.

D. Control Strategies: Verify operating control strategies, including:

1. Heat exchanger operating and high limit.
2. Early morning warm-up cycle.
3. Freeze protection.
4. Economizer cycle operation, temperature of changeover.
5. Demand Control Ventilation
6. Alarms.
7. Voltage drop across thermostat wiring.
8. Operation of remote panel, including pilot lights, failure modes.
9. Interface with Maine Controls BAS.

E. Operation and Adjustment:

1. Check for smooth, vibration-less correct rotation of supply fan impeller.
2. Adjust impeller speed as necessary and repeat measurement of fan capacity.
3. Reduce differences between fan capacity at minimum and maximum outside air less than 5%.
4. Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
5. OAD: Verify for proper travel.
6. Use smoke test to verify no short-circuiting of EA, relief air to outside air intake.
7. Check for smooth, vibration-less, correct rotation of power exhaust impeller.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners. Refer to Division 1.

END OF SECTION 15732

SECTION 15761 - AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of air coils that are not an integral part of air-handling units:

1. Hot-water.

B. Related Sections include the following:

1. Division 15 Sections for air coils that are integral to air-handling units.

1.3 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 air coil. Include rated capacity and pressure drop for each air coil.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 WATER COILS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide Trane or a comparable product by one of the following:

1. Aerofin Corporation.
2. Carrier Corporation.
3. Coil Company, LLC.
4. Dunham-Bush, Inc.
5. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
6. Super Radiator Coils.
7. USA Coil & Air.

D. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

E. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

F. Source Quality Control: Factory tested to 300 psig.

G. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.

H. Fins: Aluminum, minimum 0.006 inch thick.

I. Headers: Seamless copper tube with brazed joints, prime coated.

J. Frames: Galvanized-steel channel frame, minimum 0.052 inch thick for flanged mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.

D. Straighten bent fins on air coils.

E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 15 Section "HVAC Instrumentation and Controls," and other piping specialties are specified in Division 15 Section "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 15761

SECTION 15764 - RADIATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This Section includes the following:
   1. Convective Panel Radiators.

1.3 SUBMITTALS

A. Include specialties and accessories for each radiator type.

B. Plans, elevations, sections, and details.

C. Location and size of each field connection.

D. Enclosure joints, corner pieces, access doors, and other accessories.

E. Method of attaching hangers to building structure.

F. Unit schedules to include rated capacities, furnished specialties, and accessories.

G. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

H. Maintenance Data: For radiators to include in maintenance manuals specified in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Runtal North America Inc.
   2. Burnham.
   3. Hydrotherm.

2.2 CONVECTIVE PANEL RADIATORS

A. Basis of design: See schedule.

B. Manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end, connected by flat oval water tubes.

C. Tube shall be 0.048" minimum wall thickness.

D. Header pipes shall be square 0.109" minimum wall thickness.

E. Standard working pressure rating 56 psi.

F. Supply and return tappings shall be ¾" with a Type C configuration.

G. Finish shall be gloss powder coat for a total thickness of 2 to 3 mils.

H. Color shall be selected by Architect from submitted factory color chart.

I. Mounting shall be with factory supplied wall brackets.

J. Provide all necessary end trim pieces to make a complete finished wall to wall installation.

2.3 SOURCE QUALITY CONTROL

A. Factory test and rate baseboard radiators according to Hydronic Institute's "Testing and Rating Standard for Baseboard Radiation."

B. Factory test and rate finned-tube radiators according to Hydronic Institute's "Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all heaters per manufacturer's recommendations.

B. Install panel radiators level and plumb.

C. Install factory trim pieces as required to produce a finished wall to wall installation.

3.2 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect for damage to exposed finish. Repair damaged finish to match original finish.

END OF SECTION 15764

SECTION 15766 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This Section includes unit heaters and cabinet unit heaters.

1.3 SUBMITTALS

A. Product Data: Include specialties and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Power, signal, and control wiring diagrams. Differentiate between manufacturer-installed and field-installed wiring.
4. Equipment schedules to include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section.

E. Maintenance Data: For unit heaters to include in maintenance manuals specified in Division 1. Include maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of unit heaters and suspension system components

B. Coordinate wall construction and conditions with recessed or semi-recessed cabinet unit heater installation requirements.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish one set of spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corp.
2. Trane Company (The); North American Commercial Group.
3. Sterling
4. Vulcan

2.2 CABINET UNIT HEATERS

A. Description: An assembly including filter, chassis, coil, fan, and motor in blow-through configuration with heating coil.

B. Cabinet: For one or more of the following configurations:

1. Surface, wall, and ceiling mounting as indicated in Schedule.

a. Air Inlet: Front grille or open bottom as indicated.
b. Air Outlet: Top grille.

2. Surface wall mounted bottom open for air inlet and slope top outlet.
3. Semirecessed, wall-mounting front grilles for air inlet and outlet.
4. Semirecessed, ceiling-mounting front grilles for air inlet and outlet.
5. Recessed, wall-mounting front grilles for air inlet and outlet.

C. Chassis: Galvanized steel, with flanged edges and unit-leveling bolts.

D. Coil Section Insulation: 1-inch duct liner complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916. Fire-Hazard Classification: Duct liner and adhesive shall have a maximum flame-spread rating of 25 and smoke-developed rating of 50 when tested according to ASTM E 84.

E. Cabinet: Galvanized steel, with removable panels.

F. Cabinet Finish: Bonderize, phosphatized, and flow-coat with baked-on primer with manufacturer's standard paint, in color selected by Architect, applied to factory-assembled and -tested cabinet unit heater before shipping.

G. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and with manual air vent. Coils shall be rated for a minimum working pressure of 300 psig and a maximum entering water temperature of 275 deg F, with manual air vent.

H. Filters: 1-inch- thick, pleated glass-fiber media in fiberboard frame, Farr 30/30 or equivalent.

I. Fan:
1. Centrifugal, with forward-curved, double-width wheels and fan scrolls made of galvanized steel or thermoplastic material; directly connected to motor.
2. Shaded-pole or permanent-split capacitor, multi-speed motor with integral thermal-overload protection and resilient mounts. Connect motor to chassis wiring with plug connection.

J. Accessories
1. Steel recessing flanges for recessing cabinet unit heaters into ceiling or wall.
2. Tamperproof locks.
3. Leveling feet for vertical floor mounted cabinet unit heaters.
4. Control Devices: Unit-mounted fan-speed switch and wall-mounting thermostat.

2.3 UNIT HEATERS (HOT WATER)

A. Description: An assembly including casing, coil, fan, and motor in the following configurations as scheduled:
1. Vertical discharge configuration with radial louver diffuser in draw-through configuration
2. Horizontal discharge configuration with horizontal, adjustable louvers in blow-through configuration.

B. Casing: Galvanized steel, with removable panels.

C. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer and manufacturer's standard paint applied to factory-assembled and -tested propeller unit heater before shipping.

D. Hot-Water Coil: Copper tube, 0.031-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering water temperature of 325 deg F, with manual air vent. Test for leaks to 375 psig underwater.

E. Propeller with aluminum blades directly connected to motor.

F. Fan Motors: shaded-pole or permanent-split capacitor, with integral thermal-overload protection.

G. Accessories
   1. Horizontal Configuration: Louver fin diffuser.
   2. Vertical Configuration: Louver cone diffuser.
   3. Control Devices: Unit-mounted fan-speed switch and wall-mounting thermostat.

2.4 SOURCE QUALITY CONTROL

A. Test unit heater coils according to ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install unit heaters level and plumb.

B. Install unit heaters to comply with NFPA 90A.

C. Hung unit heaters shall be suspended from structure with rubber-in-shear vibration isolators (rubber hangers).

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

C. Install piping adjacent to machine to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

   1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safeties.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5 CLEANING

A. After installing units, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. After installing units, clean unit heaters internally according to manufacturers written instructions.

C. Install new filters in each cabinet unit heater within two weeks after Substantial Completion.

END OF SECTION 15766

SECTION 15769 - RADIANT HEATING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hydronic heating ceiling mounted panels.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which heaters and suspension systems will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling.
5. Perimeter moldings.
6. Ceiling openings and wall moldings.

D. Sample: For each type of exposed finish required, 12 by 12 inches.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of radiant heaters and panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 HYDRONIC HEATING PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rosemex Products.
2. Sun-El Corporation.
3. Sterling Mg. (basis of design)

B. Description: Linear extruded aluminum panel with serpentine water piping, suitable for lay-in installation flush with T-bar ceiling grid.

1. Panels: Minimum 0.0396-inch- thick, aluminum sheet with castellated extrusions for exposed-side finish. Support channels shall be extruded aluminum 1 ½" x ¾" x 1 1/8" thick.
2. Backing Insulation: Minimum 1-inch- thick, mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied jacket.
3. Exposed-Side Panel Finish: Baked-enamel finish in manufacturer's standard paint color as selected by Architect.
4. Factory Piping: 5/8" OD, ASTM B 88, Type L copper tube with ASME B16.22 wrought-copper fittings and brazed joints. Piping shall be mechanically bonded to panel.
5. Joining clips: zinc-plated steel springs.

C. Provide trim panels for trimming end of panels to match room dimensions.

D. Provide factory inter-connectors between adjacent series panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive radiant heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for hydronic piping connections to verify actual locations before radiant heating and cooling unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install radiant heating and cooling units level and plumb.

B. Suspend radiant heaters from structure.

C. Support for Radiant Heating and Cooling Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each panel. Locate not more than 6 inches from panel corners.
2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on panel. Wire or rod shall have breaking strength of the weight of panel at a safety factor of 3.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 15 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.

C. Install piping adjacent to unit to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. Operate electric heating elements through each stage to verify proper operation and electrical connections.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and units.

B. Remove and replace malfunctioning units and retest as specified above.

C. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain radiant heaters and panels. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 15769

SECTION 15785 - AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "HVAC Instrumentation and Controls" for control wiring and control devices connected to energy recovery units.

1.2 SUMMARY

A. This Section includes total energy recovery ventilators.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-airenergy recovery units and are based on the specific system indicated. Refer to Division 1.

B. 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASHRAE Compliance: Capacity ratings for energy recovery devices shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

E. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

F. COORDINATION

G. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.5 WARRANTY

A. Complete Unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP ENERGY RECOVERY UNITS

A. General: Packaged indoor or outdoor energy recovery ventilator consisting of an enthalpy wheel, wheel drive system, ventilation air fan, exhaust air fan, heating and/or cooling coils, necessary dampers, temperature sensors and controls. All regularly maintained parts must be serviceable in just minutes.

B. Unit Cabinet:
1. Cabinet shall be constructed of heavy gauge G90 galvanized steel with galvanized frame.
2. Unit shall include grey, baked on, polyester pre-painted galvanized steel package.
3. Unit shall have no screw penetrations on the roof. Construction shall be airtight and prevent water leaks.
4. Unit shall have lifting and forklift holes in the unit base for rigging or lifting to mounting location.
5. Cabinet shall be insulated throughout with a minimum 1" foil faced fire retardant material.
6. Main access panels shall be removable with screw fasteners to provide access to all components.
7. Enthalpy wheel shall be easily removable from the unit.

C. Operating Characteristics:

1. Unit shall be capable of providing a constant volume of air at a specified external static pressure at all fan operating speeds.

D. Blowers
1. Fan ratings are based on tests made in accordance with AMCA Standard 210.
2. Fans must be selected to operate on a stable, efficient part of the fan curve when delivering air quantities scheduled against static of the system.
3. Fan blades shall be statically and dynamically balanced and tested prior to shipment.
4. Fans shall be provided with internal vibration isolation mounts.
5. Fan discharges shall be as noted on the plans.
6. Fans shall have pillow block bearings.
7. Fan discharges shall be connected to outside wall of unit with flexible duct collar.

E. Motors
1. Motors shall be continuous duty and matched to the fan loads. Motors include motor starters.
2. Motors shall meet EPAC regulations for efficiency.
3. Motor selection must include a 15% service factor.

4. Energy wheel drive motor shall have internal overload protection.

F. Electrical Requirements
1. Unit (excluding electric post heat options) shall have single point power connection only.

2. All unit safety controls shall be factory mounted and wired, requiring only field installation of remote sensing devices and wiring to unit mounted terminals.

G. Enthalpy Wheel
1. Enthalpy wheel substrate should be of pure aluminum foil as to allow quick and efficient uptake of thermal energy, provide sufficient mass for optimum heat transfer and give maximum sensible heat recovery at low rotational speeds.
2. Energy recovery performance for the wheel shall be rated in accordance to ARI Standard 1060 and CERTIFIED to ARI. Wheels tested in independent labs in accordance to ARI Standard 1060 without ARI Certification are not acceptable.
3. Non-ARI certified wheel must be tested at a third party independent laboratory. Previously tested wheel data is not acceptable. Wheel manufacturer to include all expenses associated with the wheel testing in this proposal. Notify the Engineer and Owner four weeks in advance of wheel testing to all for witnessing and travel arrangements. All travel expenses for Owner and Engineer shall be included in the wheel manufacturer's price.
4. Enthalpy wheel shall conform to the requirements of NFPA-90A and have documented proof of smoke development of no more than 50 and flame spread of no more than 25.
5. Enthalpy drive system shall not have any take-up pulley and shall require no field adjustments by employing minimal stretch, non-adjustable drive belts.
6. Enthalpy wheel cassette shall be complete with face seal and perimeter seal to minimize EATR (Exhaust Air Transfer Ratio) when tested in accordance to ARI Standard 1060. EATR values must be certified to ARI.
7. Enthalpy wheel shall be self cleaned by two counter flow airstreams and come equipped in a slide out cassette for easy removal for maintenance.
8. Enthalpy wheel shall be cleanable with low pressure air or vacuum without degrading the latent performance and shall allow dry particles up to 800 microns to pass freely to prevent clogging of the media.
9. Enthalpy wheel comes equipped with permanently sealed ball bearings with 200,000 hour L-10 life.

H. Filtration

1. Unit shall come equipped with 2" 30% efficient supply and exhaust filters.

I. Controls

1. General
2. All service connectors shall be quick disconnect type.
3. Unit circuitry shall allow the following operational characteristics:

   a. Dry contacts for occupancy control.
   b. Variable fan speed input (if equipped).
   c. Unoccupied recirc contacts (if equipped).

J. Options

1. Frost Control
2. Exhaust Only Defrost With Unoccupied Recirculation.
3. Unit shall be equipped with the necessary dampers and control interface to allow supply fan recirculation during unoccupied times. Unit shall be equipped with exhaust only defrost to prevent excessive frost from forming on the enthalpy wheel and to maintain exhaust ventilation at all times.

K. Voltage/Speed: 460/3/60 - 1 speed

L. Roof Curb: 16"high insulated roof curb shall be provided from the factory.

M. Internal Protection
1. Unit cabinet shall be lined with a galvanized liner to provide a readily cleanable surface and to act as a vapor barrier and protect insulation from degradation.

N. Sensor Contacts
1. Control device and contacts shall be included to provide a 24 VAC signal when filters require replacing.
2. Unit shall come equipped with a wheel rotation sensor. A 24 VAC signal will be provided if the enthalpy wheel fails.

O. External Finish
1. Unit shall include white or grey, baked on, polyester pre-painted galvanized steel package. Cabinet shall withstand 10 years without cracking, chipping, peeling, brazing or spotting.
2. Unit shall be constructed of heavy guage G60 galvanized steel (indoor units only).

P. Outside Air Damper
1. Unit shall include an insulated motorized outside air damper. Unit shall have insulated dampers with a leakage rate not to exceed 5 cfm per square foot at 1 inch water column static pressure. Dampers shall be provided with extruded EPDM gasketing on the leading edges of the damper blades.

Q. Exhaust Air Damper
1. Unit shall include an insulated motorized exhaust air damper. Unit shall have insulated dampers with a leakage rate not to exceed 5 cfm per square foot at 1 inch water column static pressure. Dampers shall be provided with extruded EPDM gasketing on the leading edges of the damper blades.

R. Door Fasteners
1. Unit shall include screw fasteners and handles for unit access.

S. Outside Air Intake
1. Unit shall include end outside air intake (c/w hood).

T. Exhaust Discharge
1. Unit shall include end exhaust discharge (c/w hood).

U. Supply Discharge
1. Unit shall include down supply discharge.

V. Return Air
1. Unit shall include bottom return air.

W. Supply Filtration

1. Unit shall include 4" High Efficiency Filters (HEF) with 1" MEF pre-flters.

X. Free Cooling
1 Unit shall come equipped with a factory installed differential enthalpy controller to control free cooling.

Y. Blower Isolation
Unit shall come equipped with spring blower isolation.

Z. Energy Recovery: Aluminum Wheel
1 Unit shall come equipped with an aluminum energy recovery wheel, high effectiveness, no purge.

AA. Cassette Access
1. Unit shall come equipped with reverse cassette access to allow the energy recovery wheel to be removed from the exhaust side of the unit.

BB. Cooling Coil

1. Provide stainless drain pan for Future cooling coil.

CC. Heating Coil

1. Unit shall come equipped with a hot water post heating coil having copper tubes that are mechanically expanded into aluminum fins with a 16 gauge galvanized frame. Coils are tested in accordance with ARI 410, capacities to be as per the schedule.

DD. Control Panel

1. Unit shall come equipped with solid state controls with an integral door interlocking disconnect. Post conditioning valves, piping components and controls of coils to be field supplied.

EE. Remote Mounted Control Panel
A remote mounted control panel shall be provided to control and monitor the operation of the unit which includes:
- *Hand/Off/Auto* switch
- *Low/High* switch (if equipped with two speed motors)
- *Supply Fan On* indicator light (if equipped with single speed motors)
- *Supply Fan Low/High* indicator lights (if equipped with two speed motors)
- *Exhaust Fan On* indicator light (if equipped with single speed motors)
- *Exhaust Fan Low/High* indicator lights (if equipped with two speed motors)
- *Defrost On* indicator light (if equipped with defrost option)
- *Wheel Failure* indicator light (if equipped with wheel rotation sensor option)
- *Dirty Exhaust/Supply Filter* indicator lights (if equipped with dirty filter sensor option)
- *Free Cooling On* indicator light (if equipped with free cooling option)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturers recommendations.

B. Install heat exchangers so supply and exhaust airstreams flow in directions as indicated by manufacturer.

C. Install units with clearances for service and maintenance.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and specialties.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 15785

SECTION 15815 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 7 for fire-resistant sealants
2. Division 8 for access doors
3. Division 15 Section "Basic Mechanical Materials and Methods"
4. Division 15 Section "Mechanical Insulation"
5. Division 15 Section "Air Terminals"
6. Division 15 Section "Diffusers, Registers, and Grilles."
7. Division 15 Section "Control Systems Equipment" for automatic volume-control dampers and operators.
8. Division 15 Section "Testing, Adjusting, and Balancing" for air balancing and final adjusting of manual-volume dampers.

1.2 SUMMARY

A. This Section includes ducts and plenums for heating, ventilating, and air-conditioning systems.

1.3 SYSTEM DESCRIPTION

A. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which maybe altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

1.4 SUBMITTALS

A. Product Data: For duct liner and sealing materials.

B. Louvers

1. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
2. Color Chart for Initial Selection: For units with factory-applied color finishes.

3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

C. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Fire dampers: Provide complete submittal information (including installation instructions) and the manufacturer's certification of compliance with these specifications for approval prior to bidding. Contractor shall include damper manufacturer's Installation Instructions as part of the fire damper submittal. These instructions shall describe the applicable requirements for damper sleeve thickness, retaining angles, methods of attachment, duct-to-sleeve connections, preparation of wall or floor openings, and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL Standard 555 qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations.
5. Duct silencers, including certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.
6. Duct-mounted access doors and panels.
7. Flexible ducts.

D. Ductwork:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating pressure classifications and sizes on plans.
3. Fittings.
4. Reinforcement and spacing.
5. Seam and joint construction.
6. Penetrations through fire-rated and other partitions.
7. Terminal unit, coil, and related installations.
8. Hangers and supports, including methods for building attachment
9. Seismic restraints.

E. Coordination Drawings; provide to avoid field conflicts:

1. Show the following for new work:

   a. Ceiling suspension assembly members.
   b. Other systems installed in same space as ducts.
   c. Ceiling- and wall-mounted access doors and panels required providing access to dampers and other operating devices.
   d. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

2. Areas of building where coordination drawings are required:

   a. Mechanical Mezzanine **(Bid Alternate No 3)**

F. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.

G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

H. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.`` Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

I. Duct Silencers: The manufacturer shall supply certified test data for each scheduled silencer. The data shall include dynamic insertion loss, generated noise and pressure drop for forward or reverse flow, matching the project's air distribution system requirement. All ratings shall be conducted in the same facility and shall utilize the same silencer. Silencer performance must have been substantiated by laboratory testing according to ASTM E-477-99 and so certified when submitted for approval.

J. Louver Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

K. The contractor must comply with the enclosed specification in its entirety. If on inspections, the engineer finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.

L. At the discretion of the engineer, sheet metal gauges, and reinforcing may be randomly checked to verify all duct construction is in compliance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and fire stopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant and fire stopping materials according to manufacturer's written recommendations.

C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

D. Duct liner shall be kept clean and dry during transportation, storage and installation. Care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

E. All ductwork and fittings delivered and stored on the job site must be capped to prevent the entry of moisture, construction dust or other debris.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel, normal service: Lock-forming quality; ASTM A 653, G60 or G90 as indicated.

B. Galvanized ductwork to be painted shall have a Galvaneal finish.

C. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.

D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALANT MATERIALS

A. Joint Sealant/Mastic: Shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall prevent the entry of water, air and moisture into the duct system. Sealer shall be UL 723 and UL 181 listed and meet NFPA 90A requirements.

1. Maximum 5 flame spread and 0 smoke developed (ASTM E-84 Tunnel Test).
2. Generally provide liquid sealant for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.
3. Resistance to mold, mildew and water: Excellent
4. Color: Gray

B. Flange Gasket: A butyl rubber gasket which complies with UL Standard 181 and 723 testing and meets Mil-C 18969B and TTS-S-001657. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth. Approved: Ductmate 440 Butyl gasket tape.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.

B. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Materials: Sheet steel or round, threaded steel rod. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
3. Maximum allowable deflection for transverse joints and intermediate reinforcements will not exceed 0.250 inch.
4. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. Snap-lock seams are not acceptable.
5. If SMACNA seal class A or B is specified, the longitudinal seam shall be sealed from the inside.

B. Slide-on Transverse Joint Connectors: Prefabricated slide-on transverse duct connectors and components will be accepted. Duct constructed using prefabricated systems will refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement(s). Approved connection systems: Ductmate Industries: or W.D.C.I.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of un-braced panel area, unless ducts are lined. All large ducts must be braced as required to prevent drumming.

D. Fittings per SMACNA acceptable, specific fittings requirements below:

1. Fig. 2-3 Rectangular Elbows: Type RE2 square throat with vanes or Type RE1 radius.
2. Fig. 2-5 Rectangular Divided Flow Branches: Type 1, Type 2, Type 4A, or 4B.
3. Fig. 2-6 Branch Connections: 45-degree entry. 45-degree lead-in, bell-mouth (single diffuser supply only).
4. Fig. 2-7 Offsets and Transitions. Use gradual offsets as shown, 90-degree offsets shall be avoided.
5. Fig. 2-8 Obstructions

6. Fig 2-9 Duct Coils: Hot water heating coils with transitions and access door as shown.

E. Seismic Restraint For Ductwork: Design and installation to meet the criteria listed above, and meet requirements of the latest Sheet Metal and Air Conditioning Contractors National Association (SMACNA), Seismic Restraint Manual Guidelines for Mechanical Systems for the prescribed Seismic Hazard Level (SHL) A.

2.5 ROUND DUCT FABRICATION

A. Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" latest edition.

B. Round ducts shall be as follows:

1. Exposed Round Ducts: Shall be Spiral Seam (RL-1 seam) at 2-inch wg construction.
2. Concealed Round Ducts: Shall be longitudinal Grooved Seam Flat lock (RL-5 seam) at 2-inch wg construction.
3. Snap lock seams *shall not* be used for this project.

C. Round Joints:

1. Up to 20" diameter: Interior slip coupling beaded at center and fastened to duct with screws shall be used to join ducts. Seal joint with an approved sealing compound, continuously applied around joint prior to assembling and after fastening, making certain that majority of sealant resides on interior of the joint.
2. 21" and larger: Install using a three-piece, gasketed flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure band, which compress the gasket between the internal flanges. Ductmate Spiralmate or equivalent system.

2.6 ROUND DUCT FITTING FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

C. Elbows: Diameters3 through 8 inches shall be two section die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

2.7 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without

vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

B. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

D. Jackshaft: 1-inch- diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.8 FIRE DAMPERS

A. Fire Dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules. Dampers shall meet the requirements of the latest edition of NFPA 90A.

B. Dampers shall be tested, rated and labeled in accordance with the latest edition of UL Standard 555. Dampers shall have a UL555 fire rating of 11/2 hours. Each damper shall be equipped with a heat responsive device which has been tested and approved for use with the damper assembly in accordance with UL555. The heat responsive device shall have a temperature rating of 165 °F. Dampers shall be UL labeled for use in dynamic systems. The damper shall have a dynamic closure pressure rating of 4 in. wg.

C. Damper actuator shall be manual quadrant. Manufacturer's submittal data shall indicate actuator space requirements around the damper.

D. UL555 Dynamic Closure Ratings shall be qualified for airflow and pressure in either direction through the damper. UL ratings shall allow for mounting damper vertically (with blades running horizontal) or horizontally.

E. The Damper Manufacturer's submittal data shall certify all air performance pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3 and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D.

F. Damper blades shall be 16 ga. galvanized steel 3 Vee type with three longitudinal grooves for reinforcement. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow and operation in either direction through the damper (blades that are non-symmetrical relative to their axle pivot point or utilize blade stops larger than 0.5 in. are unacceptable).

G. Damper frames shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearings shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Jamb seals shall be stainless steel compression type.

H. The basis of design is Greenheck Model DFD-210.

2.9 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

1. Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically.
2. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted.
3. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.

2.10 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. Provide access doors of adequate size to allow easy access to the equipment that will require maintenance. Provide insulated or acoustical lined doors where duct is of the same construction.

B. Systems designed for 3" w.g. and less (SMACNA Seal Class B or C) shall utilize a hinged, cam or hinged & cam, square-framed access door.

C. Systems designed for 4" w.g. and above (SMACNA Seal Class A) shall utilize a sandwich-type access door. Construct doors in accordance with Figure 2-10 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition.

D. Manufacturer to provide an installed neoprene gasket around perimeter of access door for airtight seal.

E. Acceptable manufacturers: Ductmate Industries, Inc. or approved equal

2.11 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1. Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

B. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene or neoprene. Minimum Weight: 26 oz./sq. yd.. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.12 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1. Flame Spread: Less than 25 Smoke Developed: Less than 50.

B. All products shall be certified by Greenguard Environmental Institute; independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Greenguard provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.

C. Rated Positive Pressure: 10" w.g. per UL-181. Maximum negative pressure: ¾".

D. Flexible Ducts, Un-insulated: A triple lamination of metallized polyester, aluminum foil, and polyester shall encapsulate a steel wire helix. Basis of Design: Atco #50

E. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- thick (R = 6.0), glass-fiber insulation around a continuous inner liner.

1. Thickness: 1", R4.2, Basis of Design: Atco #80
2. Thickness: 1-1/2", R6.0, Basis of Design: Atco #86
3. Reinforcement: Steel-wire helix encapsulated in inner liner.
4. Outer Jacket: Polyethylene film.
5. Inner Liner: Polyethylene film.

F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

PART 3 - EXECUTION

3.1 MATERIALS

A. Hangers, accessories, and dampers shall be same material as parent duct.

B. All ducts shall be G60 galvanized steel except as follows:

1. Exterior Ductwork: G90 galvanized steel. Hangers and attachments shall be electro-galvanized, all-thread rod or galvanized rods with threads painted after installation.
2. Exposed Ductwork: Galvaneal (ready for paint)
3. Plenums at outside louvers: G60 galvanized steel, water-tight, pitched to drain.

3.2 DUCT CLASSIFICATIONS AND SEALANG

A. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

1. Supply duct upstream of VAV terminal units shall be constructed for a minimum pressure class of 3 in. w.g.
2. Supply Ducts downstream of VAV terminal units: 2-inch wg.
3. Supply Ducts:

4. Return Ducts: 2-inch wg, negative pressure.
5. Exhaust Ducts: 2-inch wg, negative pressure.

B. Seam And Joint Sealing

1. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
2. Seal to SMACNA Class A; all joints, longitudinal and transverse seams, and connections in ductwork shall be securely fastened and sealed with welds, gaskets, or duct sealant. Exceptions:

    a. Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. wg pressure classification.
    b. Exposed exhaust or return ducts operating at less than 2 in. wg pressure classification.

3. Seal externally insulated ducts before insulation installation.

3.3 DUCT INSTALLATION, GENERAL

A. Construct and install each duct system for the specific duct pressure classification indicated.

B. Install ducts in lengths not less than 12 feet, unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct.

F. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Firestopping materials and installation methods are specified in Division 7.

N. Where ducts penetrate mechanical room floors provide 4-inch high concrete curbs.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 DUCT ACCESSORIES INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".

B. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards

C. Adjust operable devices for proper action.

D. Perform the following as directed by the controls contractor:

1. Installation of:

   a. Automatic control dampers.
   b. Smoke detectors.
   c. Necessary blank off plates.
   d. Access doors where and as required.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from fire dampers, smoke detectors and all other components that require servicing.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining per equipment manufacturers' requirements.
2. Install access panels on side of duct where adequate clearance is available.

F. Control Damper Installation

1. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
2. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
3. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 1/8 in. of each other.
4. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
6. Provide a visible and accessible indication of damper position on the drive shaft end.
7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
8. After installation of low-leakage dampers with seals, caulk between frame and duct opening to prevent leakage around perimeter of damper.

G. Fire Damper Installation

1. All fire damper installations shall comply with the manufacturer's installation instructions or any submitted deviations and must be acceptable to the appropriate authority having jurisdiction.

2. Contractor shall provide suitable access at each fire damper to allow inspection, cycling or testing of the fire damper and replacement of the fusible link. This includes furnishing and installing duct access doors and wall or ceiling access panels as may be required.
3. Contractor installing fire dampers shall be responsible for these access doors and panels.

3.6 DUCT LINER INSTALLATIONS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner. All joints shall be neatly butted and there shall be no interruptions or gaps. Duct liner shall be installed with the printed air stream surface treatment exposed to the air stream.

B. Duct liner shall be adhered to the sheet metal with 90% (minimum) coverage of adhesive complying with the requirements of ASTM C 916.

C. All transverse edges that are not to receive sheet metal nosing shall be coated. Longitudinal joints shall occur at the corners of ducts. If duct size and standard duct liner product dimensions make exposed longitudinal joints necessary, such joints shall be coated with adhesive designated for duct liner application and which meets the requirements of ASTM C 916. Such joints shall be additionally secured with mechanical fasteners in accordance with NAIMA FGDLS, or SMACNA HVAC DCS as if they were transverse joints.

D. Duct liner shall be additionally secured with mechanical fasteners complying with the requirements NAIMA FGDLS or SMACNA HVAC DCS and of the correct type for the duct liner being installed. Fasteners may be either weld-secured or impact-driven, and shall be installed perpendicular to the duct surface. Mechanical fasteners shall not compress the insulation more than 1/8" based on nominal insulation thickness. Fastener spacing with respect to interior duct dimensions shall be in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fastener heads or washers shall have a minimum area of 0.75 in^2, with beveled or cupped edges to prevent their cutting into the duct liner.

E. Where air velocities exceed 4000 fpm, metal nosing (either channel or "zee" profile) shall be installed on upstream edges of liner duct sections.

F. Metal nosing shall be securely installed over transverse liner edges facing the airstream at fan discharge and at any point where lined duct is preceded by unlined duct.

G. Duct liner in roll form shall be folded and compressed in the corners of rectangular duct sections, or shall be cut and fit to assure a lapped, compressed corner joint.

H. Duct liner in sheet form shall be cut and fit to assure tight, over-lapped corner joints. Top pieces of liner shall be supported at the edges by the side pieces.

I. Any damage to the air stream surface must be repaired by coating the damaged area with adhesive or coating designed for duct liner application. Adhesive or coating shall meet requirements of ASTMC916.

J. Field Quality Control

1. Upon completion of installation of lined duct and before HVAC system start-up, visually inspect the ductwork and verify that duct liner has been correctly installed. Confirm that the duct system is free from construction debris.
2. After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should include, at minimum, the following steps:

    a. Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.
    b. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.
    c. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.
    d. Turn the HVAC system on and allow it to run until steady state operation is reached.
    e. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
    f. Check to ensure that air delivery performance meets all requirements and complies with SMACNA leakage specifications.

3.7 HANGING AND SUPPORTING

A. Install duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3.8 CLEANING

A. HVAC systems shall not be operated during construction.

B. All ductwork shall be provided with temporary enclosures to keep the HVAC system free of dust and construction debris. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling unit (AHU or RTU), the interior surfaces of the AHU/RTU, mixing box, coil compartment, condensate drain pans, supply air ducts, fans, fan housing, fan blades, turning vanes, filters, filter housings, reheat coils, VAV boxes, and supply diffusers are all considered

part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

C. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the **owner** reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be cleaned and subjected to re-inspection for cleanliness.

D. If cleaning is required, the procedures as outlined in Section 15890 shall be followed.

END OF SECTION 15815

SECTION 15838 - POWER AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. **EF-3 and EF-4 are covered under Bid Alternate No. 3.**

B. This Section includes the following:
1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material gages and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
7. Vibration Isolation

B. Maintenance Data: For power ventilators to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal for sound and air performance.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

E. For restaurant applications, fan shall be listed by Underwriters Laboratories (UL 762)

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Refert to Division 15 Section "Basic Mechanical Materials and Methods"

B. Coordinate size and location of structural-steel support members.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 EXTRA MATERIALS

A. Furnish one extra set of belts for each belt driving fan. Belts shall match products installed and shall be packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cook
   2. JennFan
   3. Penn Ventilation Companies, Inc.
   4. Greenheck Fan Corp.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Description: centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Upblast Units Belt-driven (Cook Model ACRU-B) or direct-driven (Cook Model ACRU-D) as scheduled. Housing: provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   4. Fan and motor isolated from exhaust airstream.

E. Accessories:

   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
   2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   4. Provide hinged sub-base with aircraft cable stop attachment.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and less wood nailer. Size as required to suit roof opening and fan base.

   1. Configuration: per roofing manufactuer's requirements.
   2. Overall Height: 16 inches.
   3. Sound Curb: Curb with sound-absorbing insulation matrix.
   4. Metal Liner: Galvanized steel.

2.3 MOTORS

A. Refer to Division 15 Section "Motors" for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 7 for installation of roof curbs. Coordinate with Division 7 for installation of Kitchen exhaust fan curb with NON combustible materials.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Equipment Startup Checks:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Verify lubrication for bearings and other moving parts.
6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
7. Disable automatic temperature-control operators.

B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.
2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

G. Replace fan and motor pulleys as required to achieve design airflow.

H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."
3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

END OF SECTION 15838

SECTION 15845 - AIR TERMINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "HVAC Instrumentation and Controls" for control devices installed on air terminals.

1.2 SUMMARY

A. This Section includes the following:

1. Single-duct air terminals.
2. Fan-powered air terminals.

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.

B. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.

C. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

E. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

B. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. Testing Requirements: Test and rate air terminals according to ARI 880, "Industry Standard for Air Terminals."

D. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

E. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

F. Comply with NFPA 70 for electrical components and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide air terminals by one of the following:

1. Trane
2. Carrier Corp.
3. Environmental Technologies.
4. Price

2.2 SINGLE-DUCT AIR TERMINALS (customized, based on Trane CO.)

A. Configuration: Volume-damper assembly inside unit casing. Locate control components inside protective metal shroud.

B. Agency Listing - The unit is UL and Canadian UL listed as a room air terminal unit. UL Control # 9N65. All Trane terminal units are ARI 880 - 98 certified.

C. Casings: 22 gauge galvanized steel. Maximum casing leakage: 7 cfm at 1-inch wg inlet static pressure.

D. Casing Lining: Minimum of 1/2-inch- thick, fiber-free insulation; 1.5-lb/cu. ft. density, complying with NFPA 90A requirements and UL 181 erosion requirements. Secure lining to prevent delaminating, sagging, or settling.

E. Plenum Air Inlets: Round stub connections.

F. Plenum Air Outlets: S-slip and drive connections.

G. Access: Removable panels to permit access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork.

H. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings. Maximum Damper Leakage: 5 cfm at 3-inch wg inlet static pressure.

I. The air inlet connection shall be an 18-gauge galvanized steel cylinder sized to fit standard round duct. A multiple point, averaging flow sensing ring shall be provided with balancing taps for measuring within +/- 5% of unit cataloged airflow. An airflow versus pressure differential calibration chart shall be provided. The damper blade shall be constructed of a closed cell foam seal mechanically locked between two 22 gauge galvanized steel disks. The damper blade assembly shall be connected to a cast zinc shaft supported by self lubricating bearings. The shaft shall be cast with a damper position indicator. The valve assembly shall include a mechanical stop to prevent over stroking. At 4.0" wg air valve leakage shall not exceed 1% of cataloged airflow.

J. Accessories

1. Attenuator Section: Line with 2-inch- thick, neoprene- or vinyl-coated, fibrous-glass insulation.
2. Multi-outlet plenum.
3. A 50 VA transformer shall be factory mounted in an enclosure with 7/8" knockouts to provide 24 VAC for controls.

K. Controls

1. The terminals will have pressure independent direct digital controls supplied and mounted by the control contractor.
2. Terminals shall be furnished with a pneumatic inlet velocity sensor. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03" wg. at an inlet velocity of 500 fpm.
3. Flow measuring taps and flow curves shall be supplied with each terminal for field balancing airflow.
4. All pneumatic tubing shall be UL listed fire retardant (FR) type.
5. Each terminal shall be equipped with labeling showing unit location, size, and scheduled cfm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards.

B. Allow adequate clearance to meet NEC on control box side of unit to meet NEC.

C. Support in accordance with SMACNA recommendations.

D. Connect ductwork to air terminals according to Division 15 ductwork Sections.

E. Slip each inlet duct over the inlet collar of the terminal. Fasten and seal the connection airtight. The diameter of the inlet duct must be equal to the listed size of the terminal; e.g. a duct that actually measures 8 inches must befitted to a size 8 terminal.

F. Inlet and outlet duct must be installed in accordance with SMACNA guidelines. Provide three (3) to five (5) equivalent duct diameters of straight duct at the inlet.

3.2 CONNECTIONS

A. Electrical: Comply with applicable requirements in Division 16 Sections.

3.3 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.5 COMMISSIONING

A. Verify that installation of each air terminal is according to the Contract Documents.

B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

C. Check that controls and control enclosure are accessible.

D. Verify that control connections are complete.

E. Check that nameplate and identification tag are visible.

F. Verify that controls respond to inputs as specified.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Review data in the maintenance manuals. Refer to Division 1.

END OF SECTION 15845

SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Duct Accessories"
3. Division 15 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Under Alternate No 1 refer to Register, Grilles and Diffusers Schedule – Note 3.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper.

1.4 SUBMITTALS

A. Each manufacturer shall check noise level ratings for registers and diffusers to insure that the sizes selected will not produce noise to exceed 30 db, "A" scale, measured at occupant level; notify Owner's representative of problems prior to shop drawing submittal.

B. Pressure drop, airflow and noise criteria selection is based on design equipment. Manufacturers not submitting design makes must provide written certification in front of submittal that equipment submitted has been checked against and performs equal to the design make.

C. Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

D. Coordinate locations with reflected ceiling plans and wall elevations as applicable.

E. Coordinate mounting frame with associated mounting surface.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 GENERAL

A. Diffusers, registers, and grilles are scheduled on Drawings.

B. Mounting type shall match the mounting surface. Coordinate with mounting conditions.

C. Material shall match the specified ductwork. Coordinate with Section 15815 "Ductwork".

D. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

2.2 RETURN OR EXHAUST

A. Return/Exhaust Grille, 45 degree deflection.

1. Material: steel (Price 530 Series)
2. Provide damper as scheduled.
3. Grilles of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center. The blades shall run parallel to the long dimension of the grille. The grille shall be finished in White Powder Coat.

B. Return/Exhaust Grille, 0- degree deflection.

1. Material: steel (Price 510Z Series)
2. Provide damper as scheduled.
3. Grilles of the sizes indicated on the plans. Grilles shall be 45 degree deflection fixed louver type with blades spaced 3/4" on center. The blades shall run parallel to the long dimension of the grille. The grille shall be finished in White Powder Coat.

2.3 SUPPLY

A. Square ceiling diffusers

1. Material: steel (Price Model SCD) or aluminum (Price Model ASCD)
2. Diffusers shall consist of a precision formed back cone of one piece seamless construction which incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
3. The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit. An inner cone assembly shall consist of 3 cones (or optional 4 cones) which drop below the ceiling plane to assure optimal VAV air diffusion performance.
4. The inner cone assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.
5. Finish shall be White Powder Coat.

B. Linear Vane Diffusers:

1. Material: Aluminum (Price Model LV1) one way deflection fixed louvers.
2. Vane depth shall be a minimal 1 3/8".
3. The core shall be of mandrel tube construction and removable from the outer border for installation.
4. The diffuser border shall be heavy extruded aluminum construction.
5. Diffusers shall have adjustable directional vanes.
6. The diffuser border shall be Type 062F (1/16") for exposed duct mounting.
7. Finish shall be White Powder Coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

B. Adjustable outlet diffuser: adjust pattern for draft-free air distribution.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 15855

SECTION 15890 - AIR DUCT CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cleaning of the following existing duct systems:
   1. **This work is covered under Bid Alternate No. 1**
   2. Supply system.
   3. Return system.
   4. Supply diffusers and return grilles.

1.3 DEFINITIONS

A. ASCS: Air system cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

B. Qualification Data: For ASCS.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

   1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
   2. Experience: Submit records of experience in the field of HVAC systems cleaning.
   3. Equipment, Materials, and Labor: Have equipment, materials, and labor required to perform specified services.

B. Comply with current published standards of NADCA.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized-Steel Sheet: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Rectangular Duct Door: Double wall; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Available Manufacturers:

a. American Warming and Ventilating.
b. Cesco Products.
c. Ductmate Industries, Inc.
d. Nailor Industries Inc.

2. Frame: Galvanized-steel sheet; with bendover tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.

C. Round Duct Door: Double wall; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

1. Available Manufacturers:

a. Flexmaster U.S.A., Inc.

2. Frame: Galvanized-steel sheet; with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- thick fibrous-glass or polystyrene-foam board.

2.4 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Duro Dyne Corp.
2. Ventfabrics, Inc.
3. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

D. Indoor-System, Flexible-Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.5 FLEXIBLE DUCTS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Hart & Cooley, Inc.
4. McGill AirFlow Corporation.

B. Noninsulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; and polyethylene vapor barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

D. Flexible-Duct Clamps: Nylon strap, in sizes 3 through 18 inches to suit duct size.

2.6 DUCT ACCESSORY HARDWARE

A. Fusible Links: Replaceable, 165 deg F rated.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine systems to determine appropriate methods, tools, and equipment required for performance of work.

B. Prepare written report listing conditions detrimental to performance of work.

C. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 CLEANING

A. Engage a qualified ASCS to clean the following systems:

1. Outside air intake.
2. Supply system.
3. Return system.
4. Grilles and Diffusers

B. Perform cleaning before air balancing or mark position of dampers and air-directional mechanical devices before cleaning.

C. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.

1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Division 15 Section "Duct Accessories" for additional duct-mounting access doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Division 15 Section "Duct Accessories" for flexible ducts.

3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors. Comply with requirements in Division 15 Section "Duct Accessories" for flexible connectors.
4. Reseal rigid-fiberglass-duct systems according to NAIMA recommended practices.
5. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Division 15 Section "Duct Accessories" for fusible links.
6. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

D. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

E. Particulate Collection and Odor Control:

1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater) particles.
2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.

F. Clean the following metal-duct system components by removing visible surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply and return fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling-unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components.

G. Mechanical Cleaning Methodology:

1. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment, and do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present; use according to manufacturer's written instructions after removal of surface deposits and debris.

H. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal-duct systems for contaminants.
3. Where contaminants are discovered, reclean and reinspect duct systems.

3.3 DUCT ACCESSORIES INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install duct-mounting access doors where access doors do not currently exist to allow for the cleaning of ducts, accessories, and terminal units as follows:

1. On both sides of duct coils.
2. Downstream from volume dampers, turning vanes, and equipment.
3. Adjacent to fire or smoke dampers; reset or install new fusible links.
4. Before and after each change in direction, at maximum 50-foot spacing.
5. On sides of ducts where adequate clearance is available.

D. Install the following sizes for duct-mounting, rectangular access doors:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body Plus Ladder Access: 25 by 17 inches.

E. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches in diameter.
2. Two-Hand Access: 10 inches in diameter.
3. Head and Hand Access: 12 inches in diameter.
4. Head and Shoulders Access: 18 inches in diameter.
5. Body Access: 24 inches in diameter.

3.4 CONNECTIONS

A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.

B. For fans developing static pressures of 5-inch wg and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.

C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inch lengths of new flexible duct.

D. Reconnect diffusers or light troffer boots to low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Reconnect existing and new flexible ducts to metal ducts with liquid adhesive plus tape draw bands.

3.5 FIELD QUALITY CONTROL

A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by Owner & Architect, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be recleaned and reverified.

B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

C. Report results of tests in writing.

END OF SECTION 15890

SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Basic Mechanical Materials and Methods"
2. Division 15 Section "Sequence of Operations"

1.2 SUMMARY

A. **Review construction documents to identify work covered under Bid Alternates.**

B. This temperature work is an expansion of the existing BAS to control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

C. Some controls equipment required in these construction documents have been previously installed in other phases of renovation in anticipation of this contract.

D. Related Sections include the following:

1. Division 13 Section "Fire Alarm"
2. Division 15 Section "Basic Mechanical Materials and Methods".
3. Division 15 Section "Sequence of Operation" for requirements that relate to this Section.
4. Division 15 Section "Testing, Adjusting, and Balancing"
5. Division 16

1.3 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and service necessary for an extension of the existing/addition to the existing building automation system.

B. The Controls Contractor's work shall consist of the provision of all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project-specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems.

C. The system shall be installed by personnel regularly employed by the manufacturer.

D. Documents are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, which are required to meet the functional intent, shall be provided without additional cost to the Owner.

E. The BAS system shall be fully compliant with Microsoft standards such that IBAS data can be displayed in and manipulated by Microsoft products without the requirement for additional middleware or translators.

F. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

B. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

C. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

D. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

E. Details of the commissioning sheets and procedures proposed.

F. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.

c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

G. Samples for Initial Selection: For each color required, of each type of senso cover with factory-applied color finishes.

H. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

I. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.5 QUALITY ASSURANCE

A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the owner's representative in writing. Spare parts shall be available for at least five years after completion of this contract.

B. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project

C. Provide a complete, neat and workmanlike installation.

D. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

G. Comply with ASHRAE 135 for DDC system control components.

H. Year-2000 Compliant: Computer hardware and software shall be capable of accurately processing, providing, and receiving date data from, into, and between the twentieth and twenty-first centuries, including leap-year calculations.

1.6 CONTRACTOR QUALIFICATIONS

A. Qualified Bidders: System shall be as manufactured, installed and serviced by Invensys (Maine Controls) - only.

1.7 SPECIFICATION COMPLIANCE REVIEW

A. The temperature control system/BAS contractor shall supply, at the time of bid opening, a paragraph-by-paragraph specification compliance report. The report shall indicate for each numbered paragraph, how the contractor meets the criteria of the paragraph. The following format must be utilized in completing the compliance report:

B. Comply - without exception.

C. Qualify - meet the functional intent. For each paragraph, the contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.

D. Does not comply – cannot meet specified function.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

B. The contractor shall protect all work and material from damage by his/her work or employees.

C. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

1.9 COORDINATION

A. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition.

B. Coordinate details of telephone line, internet service provider, and associated requirements.

C. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

D. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the controls system specified in this section. These controls shall be integrated into the system and coordinated by the contractor.

F. Sheet Metal Subcontractor:

1. Installation of automatic control dampers, , , and necessary blank off plates.
2. Access doors where and as required.
3. Furnishing and installing of smoke dampers and actuators required for duct smoke isolation. The BAS contractor shall interlock these dampers to the air handlers as described in Sequences of Operation.
4. Furnishing and installing of fire/Smoke dampers and actuators required for fire rated walls. Control of these dampers shall be by Division 16.

G. HVAC Contractor:

1. Installation of immersion wells and pressure tappings, along with associated shut-off cocks.
2. Installation of flow switches.
3. Installation of automatic control valves.
4. Installation of flow meters.

H. Testing and Balancing Contractor:

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

I. Electrical Subcontractor:

1. All power wiring and line voltage interlock wiring such as exhaust fan interlocked to supply fan.
2. All control wiring shown on electric plans such as unit heater line-voltage room thermostats.
3. Duct smoke detectors required for air handler shutdown are supplied under Division 16. Coordinate required length of sampling tube, for full span of ductwork. The contractor shall interlock smoke detectors to air handlers for shutdown as described in sequences of operation.

J. Complying with the principle of "unit responsibility" all electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings shall be included in Division 15. Electrical work shall, in general, comply with the following, unless otherwise directed by Division 16:

1. All electrical work shall comply with the N.E.C. and local electrical codes.
2. Electrical work may include both line voltage and low voltage wiring, as required.
3. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.
4. All magnetic starters furnished by Electrical Contractor for mechanical equipment shall be furnished with integral 120 volt control transformers, sized to handle the additional VA needed for the controls - pilots, EP valves, etc.
5. The motor starter supplier shall provide auxiliary contacts as required for interlock by BAS Contractor; the supplier shall estimate an allowance of at least one auxiliary contract per starter. All interlock and control wiring shown on the electrical plans is by the electrical subcontractor.

K. Coordinate with controls specified in other sections of divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2, "Communication" of this specification.
2. Each supplier of a control product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.

5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

1.10 WARRANTY

A. Refer to Division 1 Requirements.

B. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the engineer, the engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty. All work shall have a single warranty date, even when the owner has received beneficial use due to an early system start-up.

C. All components, system software, and parts supplied by the BAS contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date. The BAS contractor at no charge shall furnish Labor to repair, reprogram, or replace components during the warranty period. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 hours during normal business hours.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a unified control network. A gateway (translator) shall communicate with third-party equipment furnished or installed by others.

B. Install new wiring and network devices as required to provide a complete and workable control network.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

2.2 DDC EQUIPMENT

A. Control system provided for this project shall consist of a peer-to-peer networked, stand-alone, distributed system.

B. The BAS shall provide a high speed Enterprise Network Interface that shall plug directly into building controllers. The Network Interface shall employ Carrier Sense Multiple Access/Collision Detect (CSMA/CD) contention type protocol, which adheres to the industry standard format IEEE 802.3. The content of messages shall be the manufacturer's standard. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3 compliant Ethernet Networks. The Network Interface shall directly support connectivity to a variety of cabling types. As a minimum provide the following

connectivity: 10Base2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors), 10Base T (Twisted-Pair RJ-45 terminated UTP cabling).

2.3 CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application. This applies to building controllers and application specific controllers

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and minimum 72-hour battery backup.
2. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
3. Data Sharing: each controller share data as required with each networked BC and AAC.
4. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
5. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling, automatic system diagnostics; monitor system and report failures.
6. Controllers must comply with either of the following::

    a. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
    b. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.

7. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
8. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
9. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

10. Standard Application Programs:

    a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.

b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
e. Remote communications.
f. Maintenance management.

B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
5. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
6. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications.
7. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

E. Surge suppression shall contain telephone jack input and output in accordance with Lucent Technologies 48 VDC Standard

2.4 DAMPERS AND VALVES

A. Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

1. Control dampers shall be the parallel or opposed blade type as follows:

   a. Outdoor and/or return air mixing dampers shall be parallel blade, arranged to direct airstreams toward each other.
   b. Other modulating dampers shall be the opposed blade type.
   c. Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

2. Damper frames shall be 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
3. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades are to be suitable for medium velocity performance 2000 fpm. Blades shall be not less than 16-gauge.
4. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze or better.
5. All blade edges, top, and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 10 cfm per ft^2 4 in. w.g. differential pressure. Provide airfoil blades suitable for a wide-open face velocity of 1500 fpm.
6. Individual damper sections shall not be larger than 48 in. x 60 in. Provide a minimum of one damper actuator per section.
7. Modulating dampers shall provide a linear flow characteristic where possible.
8. Dampers shall have exposed linkages. Dampers over 48" in applications where sectioning is not applicable shall be supplied with a jackshaft to provide sufficient force throughout the intended operating range.

B. Electronic damper/valve actuation shall be provided.

1. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be IS09001 certified. Actuators shall be as manufactured by BELIMO.
2. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or setscrew type fasteners are not acceptable.
3. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

4. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
7. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
8. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
9. All proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
10. Damper actuators shall be selected in accordance with manufacturer's recommendations to provide sufficient close-off force to effectively seal damper and to provide smooth modulation control under design flow and pressure conditions. Furnish a separate actuator for each damper section.
11. Valve actuators shall provide tight close-off at design system pressure and shall provide smooth modulation at design flow and pressure conditions.
12. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
13. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.

C. Control Valves:

1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

    a. Two-way: 100% of total system (pump) head.
    b. Three-way: 100% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

3. Water Valves:

    a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
    b. Sizing Criteria:

        1) Two-position service: Line size.

2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, which ever is greater.
3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.

c. Application:
1) VAV reheat coils: two-way floating control, non spring return.
2) CUH and Convectors: two-way two position, spring open 100%.
3) AHU main heating coils: two-way modulating control, spring open 100%.
4) Fintube radiation: two-way modulating control, spring open 100%

d. Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
e. Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
f. Water valves shall fail normally open or closed, as specified.

2.5 SENSING DEVICES

A. Binary Temperature Devices

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) set point range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
2. Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint.
3. Low-limit thermostats. Low-limit air-stream thermostats shall be UL listed, vapor pressure type, with an element of 20-foot minimum length. Element shall respond to the lowest temperature sensed by any 1-foot section. Low-limit thermostats shall be manual reset.

B. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross section.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.

C. Room sensor accessories shall include the following:

1. Insulating Bases: For temperature sensors/thermostats located on exterior walls.
2. Override switch
3. Display
4. Communication port

D. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg.
d. Duct Static-Pressure Range: 0- to 5-inch wg.

2.6 STATUS SENSORS

A. Status Inputs for Fans: Current Switches; Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements

B. Status Inputs for Pumps: Current Switches; Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

2.7 WIRING AND RACEWAYS

A. Provide copper wiring, communication wiring, plenum cable, and raceways as specified in the applicable sections of Division 16.

B. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

C. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and the expense of—this contractor.

3.2 GENERAL WORKMANSHIP AND FIELD QUALITY CONTROL

A. Install all components in accordance with the manufacturer's recommendations.

B. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

C. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

E. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

F. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

G. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances.

H. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

I. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.

3.3 EXISTING EQUIPMENT

A. Wiring: Interconnecting control wiring shall be removed and become the property of the contractor, unless specifically noted or shown to be reused.

B. Pneumatic Controlled Devices; Terminate pneumatic controllers and tubing and cap supply air tight that served pneumatic devices removed and replaced with electronic devices.

C. Modify existing starter control circuits, if necessary, to provide hand/off/auto control of each starter controlled. If new starters or starter control packages are required, these shall be included as part of this contract.

D. Patch holes and finish to match existing walls.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Control and interlock wiring and installation shall comply with National Electrical Code and local electrical codes, Division 16, and manufacturer's recommendations.

B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 16.

C. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.

D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.

E. Install wiring in raceway where subject to mechanical damage and at levels below 10ft in mechanical, electrical, or service rooms.

F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

G. Do not install wiring in raceway containing tubing.

H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 10 ft intervals.

I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.

J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.

K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.

L. Include one pull string in each raceway 1 inch or larger.

M. Use color-coded conductors throughout.

N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 inches between raceway and high-temperature equipment.

P. Adhere to requirements in Division 16 where raceway crosses building expansion joints.

Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.

R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.

S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 3-feetin length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.

T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.5 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate at 48 inches above the finished floor.

C. Install guards on sensors/thermostats in the following locations:

1. Entrances.
2. Public areas.
3. All Corridors
4. Where indicated.

D. Mount sensors rigidly and adequately for the environment within which the sensor operates.

E. Room sensors shall be installed on concealed junction boxes properly supported by the wall framing.

F. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

G. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

H. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1ft of sensing element for each 1 ft² of coil area.

I. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

J. Install outdoor air temperature sensors on north wall, complete with sun shield. Architect-engineer must approve location prior to installation.

K. Differential air static pressure sensors:

1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
2. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

3.6 INSTALLATION OF ACTUATORS

A. Mount and link control damper actuators according to manufacturer's instructions.

1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.7 WARNING LABELS

A. Labels shall use white lettering (12-point type or larger) on a red background.

B. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system. Warning labels shall read as follows: "CAUTION: This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing."

C. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects. Warning labels shall read as follows: "CAUTION: This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing."

3.8 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 in. of termination with the DDC address or termination number.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1/2 in. letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to terminal box or valves with nameplates.

F. Manufacturer's nameplates and UL or CSA labels are to be visible and legible after equipment is installed.

3.9 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system if all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 10% spare I/O point capacity for each point type found at each location. A minimum of one spare is required for each type of point used.

1. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

3.10 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming: Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Imbed into the

control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:

1. Text-based:

    a. Must provide actions for all possible situations
    b. Must be modular and structured
    c. Must be commented

2. Graphic-based:

    a. Must provide actions for all possible situations
    b. Must be documented

3. Parameter-based:

    a. Must provide actions for all possible situations
    b. Must be documented

3.11 CONTROL SYSTEM CHECKOUT AND TESTING

A. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

B. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

C. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

D. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

E. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum start/stop routines.

F. Alarms and Interlocks

1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.12 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

3.14 CONTROL SYSTEM ACCEPTANCE

A. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.

B. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.15 CLEANING

A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be required to match the

adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING

A. Provide a minimum of 8 hours of training.

B. Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be **2** hours in length and must be coordinated with the building owner.

END OF SECTION 15900

SECTION 15940 - SEQUENCE OF OPERATIONS

THIS SECTION WILL BE FURNISHED VIA ADDENDUM.

END OF SECTION 15940

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 15 Section "Basic Mechanical Materials and Methods"

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Review construction documents to identify work covered under Bid Alternates.
2. HVAC Systems
3. Assist the control contractor in verifying that automatic control devices are functioning properly.
4. Reporting results of activities and procedures specified in this Section.
5. Building commissioning requirements as specified

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect. TABB "Contractors Certification Manual."

D. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm **certified** by either AABC, TABB, or NEBB.

B. TAB Firm Qualifications: Perform all work in accordance with AABC, TABB, or NEBB procedures.

C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service

representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

   a. Submittal distribution requirements.
   b. The Contract Documents examination report.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. Special Guarantee: Provide a guarantee on NEBB, AABC, or TABB forms stating that the balancing contractor will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1.

D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions.
4. Automatic modulating and shutoff valves are properly connected.
5. Sensors are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance dampers are open.
6. Smoke dampers are open.

7. Fire dampers are open.
8. Isolating and balancing valves are open and control valves are operational.
9. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
10. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, and similar controls and devices, to show final settings.

D. **TAB contractor's bid shall include the amount of $500 for fan and/or motor sheave replacement required to achieve system air flow within specified tolerance from design. All remaining portion of allowance shall be credited back to owner by the completion of TAB.**

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for

that zone. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values.

E. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Do not deadhead the pumps.
6. Set system controls so automatic valves are wide open.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

H. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.

6. Capacity: Calculate in tons of cooling.
7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.11 PROCEDURES FOR AIR COOLED CONDENSERS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.13 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a pre-construction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.15 TEMPERATURE-CONTROL VERIFICATION

A. Assist the BAS Contractor as follows:

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

B. Verify that controllers are calibrated and commissioned.

C. Check transmitter and controller locations and note conditions that would adversely affect control functions.

D. Record controller settings and note variances between set points and actual measurements.

E. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

F. Check free travel and proper operation of control devices such as damper and valve operators.

G. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

H. Check the interaction of electrically operated switch transducers.

I. Check the interaction of interlock and lockout systems.

J. Check main control supply-air pressure and observe compressor and dryer operations.

K. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

L. Note operation of electric actuators using spring return for proper fail-safe operations.

3.16 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to plus 10 percent.
3. Isolation Room Supply Air Balancing Tolerance: + 0%/-10%.
4. Isolation Room Exhaust Air Balancing Tolerance: +10%/-0%.
5. Heating-Water Flow Rate: 0 to minus 10 percent.
6. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.17 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.

d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.

h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.

h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.

L. Packaged Chiller Reports:

1. Unit Data:

    a. Unit identification.
    b. Make and model number.
    c. Manufacturer's serial number.
    d. Refrigerant type and capacity in gal..
    e. Starter type and size.
    f. Starter thermal protection size.
    g. Compressor make and model number.
    h. Compressor manufacturer's serial number.

2. Air-Cooled Condenser Test Data (Indicated and Actual Values):

    a. Refrigerant pressure in psig.
    b. Refrigerant temperature in deg F.
    c. Entering- and leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model and serial numbers.
    f. Water flow rate in gpm.
    g. Water pressure differential in feet of head or psig.
    h. Required net positive suction head in feet of head or psig.
    i. Pump rpm.
    j. Impeller diameter in inches.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.
    c. Actual impeller size in inches.
    d. Full-open flow rate in gpm.
    e. Full-open pressure in feet of head or psig.
    f. Final discharge pressure in feet of head or psig.
    g. Final suction pressure in feet of head or psig.
    h. Final total pressure in feet of head or psig.
    i. Final water flow rate in gpm.
    j. Voltage at each connection.
    k. Amperage for each phase.

N. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and type.
    e. Model and serial numbers.

2. Motor Data:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. If fans are an integral part of the unit, include the following for each fan:

    a. Make and type.
    b. Arrangement and size.
    c. Sheave make, size in inches, and bore.
    d. Sheave dimensions, center-to-center, and amount of adjustments in inches.

4. Test Data (Indicated and Actual Values):

    a. Total exhaust airflow rate in cfm.
    b. Purge exhaust airflow rate in cfm.
    c. Outside airflow rate in cfm.
    d. Total exhaust fan static pressure in inches wg.
    e. Total outside-air fan static pressure in inches wg.
    f. Pressure drop on each side of recovery wheel in inches wg.
    g. Exhaust air temperature entering in deg F.
    h. Exhaust air temperature leaving in deg F.
    i. Outside-air temperature entering in deg F.
    j. Outside-air temperature leaving in deg F.
    k. Calculate sensible and total heat capacity of each airstream in MBh.

3.19 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Measure sound levels at two locations.
    e. Measure space pressure of at least 10 percent of locations.
    f. Verify that balancing devices are marked with final balance position.
    g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner &Architect.
2. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
3. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

4. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
5. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.20 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Common electrical installation requirements.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

I. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.4 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 16050

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Ground rods.
2. Grounding arrangements and connections for separately derived systems.

C. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, minimum 12" long unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 by 96 inches (16 by 2400 mm) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid or stranded conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Grounding Bus: Install in electrical and telephone equipment rooms and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

END OF SECTION 16060

SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

B. Related Sections include the following:

1. Division 16 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper B-Line, Inc.; a division of Cooper Industries.
   b. ERICO International Corporation.
   c. Thomas & Betts Corporation.
   d. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or

cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Hilti Inc.
3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073

SECTION 16074 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Restrained spring isolators.
   2. Channel support systems.
   3. Restraint cables.
   4. Hanger rod stiffeners.
   5. Anchorage bushings and washers.

B. Related Sections include the following:

   1. Division 16 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

   1. Site Class as Defined in the IBC: D.
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.

      a. Component Importance Factor: 1.0.
      b. Component Response Modification Factor: 3.0.
      c. Component Amplification Factor: 3.5.

   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.370g.
   4. Design Spectral Response Acceleration at 1.0-Second Period: 0.099g.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

    a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 16 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Mason Industries.
3. Vibration Isolation.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hilti Inc.
3. Mason Industries.
4. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive.

Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on distribution transformers.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16074

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.145.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:
   1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.3 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength: 50 lb (22.6 kg), minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Power-Circuit Conductor Identification: For conductors No. 4 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductors, identify phase in addition to the above.

B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels or baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

F. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power,

lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Transformers.
   d. Emergency system boxes and enclosures.
   e. Disconnect switches.
   f. Enclosed circuit breakers.
   g. Motor starters.
   h. Contactors.
   i. Voice and data cable terminal equipment.
   j. Master clock and program equipment.
   k. Intercommunication and call system master and staff stations.
   l. Television/audio components, racks, and controls.
   m. Fire-alarm control panel and annunciators.
   n. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder and branch-circuit conductors.

   1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 16 Section "Voice and Data Communication Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN, in raceway; Power-limited cable, concealed in building finishes.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, and boxes.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. NBR: Acrylonitrile-butadiene rubber.

G. RNC: Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings.

B. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Electri-Flex Co.
5. O-Z Gedney; a unit of General Signal.
6. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel or aluminum.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel, set-screw or compression type.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CANTEX Inc.
2. CertainTeed Corp.; Pipe & Plastics Group.
3. Lamson & Sessions; Carlon Electrical Products.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. RACO; a Hubbell Company.
2. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit, IMC, or EMT.
3. Underground Conduit: RNC, Type EPC-40 -PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

a. Loading dock.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 16 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from RNC to rigid steel conduit or IMC before rising above the floor.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

J. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

K. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

L. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.5 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Line-voltage snap switches.
4. Pendant cord-connector devices.
5. Cord and plug sets.

B. Related Sections include the following:

1. Division 16 Section "Voice and Data Communication Cabling" for workstation outlets.
2. Division 16 Section "Lighting Control Devices" for photo-electric controls an occupancy sensing controls.
3. Division 16 Section "Lighting Controls" for low-voltage switches associated with lighting control system.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; TR8300.
b. Hubbell; HBL8300SG.
c. Leviton; 8300-SGG.
d. Pass & Seymour; 63H.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Receptacles: Comply with NEMA WD 1, NEMA WD 6, and UL 498.

2.5 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 LINE-VOLTAGE SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 1995L.
b. Hubbell; HBL1557L.
c. Leviton; 1257L.
d. Pass & Seymour; 1251L.

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles oriented to match existing receptacles. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Outdoor photoelectric switches.
2. Switch-box occupancy sensors.
3. Indoor occupancy sensors.

B. Related Sections include the following:

1. Division 16 Section "Building Lighting Control System" for low-voltage, manual and programmable lighting control systems.
2. Division 16 Section "Wiring Devices" for wall-box dimmers and multipole contactors.

1.3 SYSTEM DESCRIPTION

A. Except as otherwise noted or indicated, items specified in this section are intended to operate independent of the Building Lighting Control System and are not connected to it.

B. The general design intent is that all new or renovated spaces include a means of automatically turning off lighting. This feature is generally provided for each space by either an occupancy sensor or by connection to a lighting control panel with time-schedule control.

C. Refer to Division 16 Section "Building Lighting Control System" for further information regarding control for spaces that do not include occupancy sensing controls.

D. Refer to the details on the drawings for further information regarding control schemes and components.

1.4 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, and coverage area of each sensor.
2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design manufacturer for materials specified under this section is Leviton. Refer to drawings for model numbers used in various applications. Substitutions are acceptable in accordance with Division 1. If Substitutions are proposed, the Contractor shall be responsible for providing all components, materials, labor, wiring, etc. as required to achieve the functions and features of the specified products.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 SWITCH-BOX OCCUPANCY SENSORS

A. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.
2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present. This feature shall be capable of being enabled or disabled in the field. Set for disabled.
3. Configure occupancy sensors for manual-on/automatic-off operation.

2.4 INDOOR OCCUPANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted though a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

B. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on an 8-foot- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

C. Dual-Technology Type: Wall mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage: Detect occupancy anywhere within an area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 16 Section " Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 16 Section "Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 16 AWG, complying with Division 16 Section "Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing controllers and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 16145

SECTION 16200 – BUILDING LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting controls:

1. Hardwired, low-voltage control.
2. Digital control.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for wall-box dimmers and multipole contactors.
2. Division 16 Section "Lighting Control Devices" for photoelectric switches and occupancy sensors.

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

D. PC: Personal computer; sometimes plural as "PCs."

E. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.

F. RS-485: A serial network protocol, similar to RS-232, complying with TIA/EIA-485-A.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.

1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data

communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

D. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

E. Software Upgrade Kit: For Owner to use in modifying software to upgrade and to allow system expansion.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.

B. Coordinate lighting control components specified in this Section with components specified in other Sections, including the following:

1. Division 16 Section "Lighting Control Devices."
2. Division 16 Section "Wiring Devices."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Software: Failure of input/output to execute switching or dimming commands.
b. Failure of modular relays to operate under manual or software commands.
c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Cost to repair or replace malfunctioning parts for two years from date of Substantial Completion.
3. Extended Warranty Period: Cost of replacement parts that failed in service due to transient voltage surges (materials only, f.o.b. the nearest shipping point to Project site) for eight years.
4. Extended Warranty Period: Cost to repair or replace electrically held relays for 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Electrically Held Relays: Equal to five percent of amount installed, but no fewer than ten relays.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of design is the Leviton Z-Max system, with control cards and all optional features required to provide all functions specified herein and indicated on the drawings. If a substitution is proposed, the Contractor shall bear full responsibility for providing all components, features, wiring, programming etc. required to provide all control scenarios and features of the specified system.

2.2 SYSTEM REQUIREMENTS

A. Expansion Capability: Adequate to increase the number of control functions in the future by 25 percent more than those indicated. This expansion capability applies to equipment ratings, housing volumes, spare relays, terminals, number of conductors in control cables, and control software.

B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.

2.3 FUNCTIONAL SYSTEM DESCRIPTION

A. A manual switch, an internal timing and control unit, or an external sensor or other control signal source sends a signal to programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits for groups of lighting fixtures or other loads.

B. The general design intent is that all spaces in new or renovated areas include a means of automatically turning off lighting. This feature is generally provided for each space by either an occupancy sensor or by connection to a lighting control panel with time-schedule control. Unless otherwise noted, spaces with occupancy sensors are not connected to the system specified in this section, and spaces without occupancy sensors are intended to be connected to the system specified in this section.

C. Refer to Lighting Control Panel Schedules at the end of this section and on the drawings for further information.

D. Except as otherwise noted, the control scheme for relays connected to the building lighting control system shall be manual-on/scheduled-off with manual override provided by the manual switches. Final time schedules shall be determined during programming consultation meetings described in Part 3 of this section.

E. Refer to Division 16 Section "Lighting Control Devices" for further information regarding control for spaces that include occupancy sensing controls.

F. Refer to the details on the drawings for further information regarding control schemes and components.

2.4 CONTROL MODULE

A. Control Module Description: Programmable; complying with UL 508; microprocessor-based control unit mounted in preassembled modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units can receive inputs from indicated sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.

1. Control modules shall be networked according to the Lighting control panel schedules at the end of this section.

2.5 POWER DISTRIBUTION COMPONENTS

A. Modular Relay Panel: Complying with UL 508 and UL 916; factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.

1. Cabinet: Steel with hinged, locking door.

    a. Barriers separate low-voltage and line-voltage components.
    b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
    c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.

2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.

    a. Low-Voltage Leads: Plug connector to connector strip in cabinet and pilot light power where indicated.
    b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
    c. Endurance: 50,000 cycles at rated capacity.
    d. Mounting: Provision for easy removal and installation in relay cabinet.

2.6 MANUAL SWITCHES AND PLATES

A. Switches: Modular, momentary low-voltage type.

1. Pushbutton or key operated, center off type as indicated on the drawings.
2. Color: ivory, unless otherwise indicated.
3. Integral Pilot Light: Indicate when circuit is on. Use where indicated.
4. Wall Plates: Match those specified in Division 16 Section "Wiring Devices" for materials, finish, and color. Use multi-gang plates if more than one switch is indicated at a location.
5. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 16 Section "Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 16 Section "Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with copper conductors not smaller than No. 16 AWG, complying with Division 16 Section "Conductors and Cables."

D. Network cable shall be as recommended by the system manufacturer.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Wiring Method: Install wiring in raceways except where installed in accessible ceilings and gypsum board partitions. Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

3.3 PROGRAMMING CONSULTATION

A. A factory-authorized service representative shall attend a minimum of three, four-hour meetings at the project site with the Architect and Owner's Representative to determine final time schedules and programming. Meetings shall be scheduled with Owner's Representative through the Architect.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls. Provide a minimum of two four hour sessions at the project site plus associated travel time to and from the site for each session. Refer to Division 1. Training shall be professionally videotaped as part of the work of this section.

END OF SECTION 16200

SECTION 16420 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.

B. Related Sections include the following:

1. Division 15 for variable speed drives.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed controllers, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For manufacturer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect and Owner no fewer than ten days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.

C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: three of each type and rating.
2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the specified manufacturers.

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Eaton Corporation; Cutler-Hammer Products.
3. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
4. Siemens/Furnas Controls.
5. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power source of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

B. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
2. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.3 ENCLOSURES

A. Description: Surface-mounting cabinets. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

3.4 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 16 Section "Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 16 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division.

END OF SECTION 16420

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Transient voltage suppression for panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Owner no fewer than ten days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the specified manufacturers.

1. Panelboards, Overcurrent Protective Devices, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.
b. Siemens Energy & Automation, Inc.
c. Square D.

2.2 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets as indicated. NEMA PB 1, Type 1.

1. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

C. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity or Tin-plated aluminum.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
3. Extra-Capacity Neutral Bus, where scheduled: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Mechanical type.
3. Sub-feed Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 TRANSIENT VOLTAGE SUPPRESSION – Provide where Scheduled

A. Transient Voltage Suppression Device: IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.

1. Minimum Single-Impulse Current Ratings:

a. Line to Neutral: 100,000 A.
b. Line to Ground: 100,000 A.
c. Neutral to Ground: 50,000 A.

2. Protection modes shall be as follows:

a. Line to neutral.
b. Line to ground.
c. Neutral to ground.

3. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
4. Maximum Category C Combination Wave Clamping Voltage: 600 V, line to neutral and line to ground on 120/208 V; 1000 V, line to neutral and line to ground on 277/480 V systems.
5. Maximum UL 1449 Clamping Levels: 400 V, line to neutral and line to ground on 120/208 V; 800 V, line to neutral and line to ground on 277/480 V systems.
6. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
7. Accessories:

a. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
b. Audible alarm activated on failure of any surge diversion module.
c. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
8. Circuit to be provided within existing panelboards shall be UL listed for use with the existing panelboard manufacturer and series.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16461 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the specified manufacturers.

1. ACME Electric Corporation; Power Distribution Products Division.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

I. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

J. Electrostatic Shielding for K-Factor Rated Transformers: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

    a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
    c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 16 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 16461

SECTION 16491 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches and controllers.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1, include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Three of each fuse type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Feeders: Class RK5, time delay.

B. Motor Branch Circuits: Class RK1, time delay.

C. Other Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

SECTION 16511 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Refer to drawings for light fixture schedules.

1.2 SUMMARY

A. This Section includes the following:
1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.

B. General notes:

1. Catalog series numbers are used to establish a level of quality and not intended to limit competition. Series numbers are not complete catalog numbers. Comply with additional requirements in specifications and drawings.
2. Except as indicated otherwise on fixture schedule, suspended light fixtures shall be furnished and installed complete with steel stem sets, and pieces and aligners with aligner type canopies as manufactured by respective fixture manufacturer.
3. Pendant mounting heights are to bottom of fixture. Verify exact mounting heights of pendant fixtures with architect prior to roughing.
4. Wall mount fixture heights are to centerline unless noted otherwise. Verify exact mounting heights and locations of wall mounted lighting with architect prior to roughing.
5. Refer to reflected ceiling plans for exact location of ceiling mounted lighting and devices.
6. Provide trim and mounting accessories for recessed lighting fixtures which are compatible with the type of ceiling construction in which they are to be mounted. Refer to reflected ceiling plans and room finish schedules.
7. Light fixture locations in mechanical rooms and electric rooms are approximate. Install lighting to avoid ductwork, piping and electrical items.
8. Provide wire guards where indicated on floor plans or schedules.

1.3 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
   1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

E. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of fixture, including dimensions and verification of indicated parameters.
   2. Emergency lighting unit battery and charger.
   3. Fluorescent and high-intensity-discharge ballasts.
   4. Lamps.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Wiring Diagrams: Power, signal, and control wiring.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Electronic Ballasts: 5 years from date of Substantial Completion.
   2. Warranty Period for Electromagnetic Ballasts: 3 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598.

C. Fluorescent Fixtures: Comply with UL 1598.

D. HID Fixtures: Comply with UL 1598. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

H. Plastic Diffusers, Covers, and Globes:
1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.2 FLUORESCENT LAMP BALLASTS

A. Description: Include the following features, unless otherwise indicated:
1. Designed for type and quantity of lamps indicated at full light output.

B. Electronic ballasts for T8 lamps: Basis of Design is Sylvania PSX Xtreme system
1. Approved equal is Optanium by Advance Transformer Co.
2. Proposals for equipment of other manufacturers will be considered provided sufficient documentation is submitted to establish that it meets these specifications. The price for alternate equipment must be identified as an alternate bid and the amount stated as an addition or deduction to the base bid. Any revision or addition to the wiring required by substitute equipment shall be the responsibility of the substituting contractor.

a. Design intent is to provide lamp/ballast systems with the following system lumen ratings. Substitutions will not be considered unless system lumens for the proposed lamp/ballast systems are equivalent to specified system as evidenced by manufacturer's literature indicating system rating the particular lamp/ballast combination proposed.
   1) 2-lamp ballast system lumens: 4470
   2) 3-lamp ballast system lumens: 6710
   3) 4-lamp ballast system lumens: 8940

b. Substitutions that offer instant-start ballasts will not be considered.

3. Ballasts shall include the following features, unless otherwise indicated:
   a. Comply with NEMA C82.11.
   b. Programmed Rapid Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
   c. Ballast factor: .71
   d. Sound Rating: A
   e. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11.
   f. Transient Voltage Protection: IEEE C62.41, Category A.

C. Electronic Ballasts for T5 lamps: Basis of Design is Sylvania QTP quicktronic series.
   1. Approved equals are Centium T5 series by Advance Transformer Company and Triad T5 series by Universal Lighting Technologies.
   2. Ballasts shall include the following features, unless otherwise indicated:
      a. Comply with NEMA C82.11.
      b. Programmed Rapid Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
      c. Ballast factor: 1.0 minimum.
      d. Sound Rating: A
      e. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11.
      f. Transient Voltage Protection: IEEE C62.41, Category A.

D. Ballasts for compact lamps in recessed fixtures shall have the following features, unless otherwise indicated:
   1. Type: Electronic
   2. Power Factor: 90 percent, minimum.
   3. Flicker: Less than 5 percent.
   4. Lamp end-of-life detection and shutdown circuit.
   5. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
   6. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

E. Ballasts for compact lamps in nonrecessed fixtures shall include the following features, unless otherwise indicated:
   1. Power Factor: 90 percent, minimum.
   2. Ballast Coil Temperature: 65 deg C, maximum.
   3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
   4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.3 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated.
1. Type: Constant-wattage autotransformer type.
2. Minimum Starting Temperature: Minus 22 deg FMinus 30 deg C for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F40 deg C.
4. Open-circuit operation that will not reduce average life.

B. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

C. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

2.4 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Integral self-contained nickel-cadmium emergency power source.

2.5 EMERGENCY LIGHTING UNIT

A. General: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: heavy-chrome-plated wire guard protects lamp heads or fixtures.
5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.
6. Remote Heads shall be exterior weatherproof, vandalproof
7. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

2.6 LAMPS: Provide as indicated in schedule for each fixture type.

A. T8 linear fluorescent lamps shall be high lumen type. Basis of design for 48" lamp is Sylvania FO32XPS 3000°K 800 series.
   1. Approved equals are Phillips ALTO Advantage series and GE ULTRA High Lumen with Starcoat.

B. T5 linear flourescent lamps: Basis of design is Sylvania Pentron series.
   1. Approved equals are Phillips and GE.

C. Lamps shall be 3000°K with minimum 80 CRI.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 16 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated,12 gage

E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch-minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

   1. Cable length shall be field adjustable.

2.8 FINISHES

A. Fixtures: Manufacturers' standard, unless otherwise indicated.
   1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
   2. Metallic Finish: Corrosion resistant.

2.9 SOURCE QUALITY CONTROL

A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings:
1. Install a minimum of 2 ceiling support system rods or wires for each fixture connected to the building structure. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least wires connected to structure
4. Do not support fixtures solely from suspended ceiling
5. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Fixture Support: As follows:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable.

D. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

END OF SECTION 16511

SECTION 16721 - FIRE ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fire alarm systems.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for electric door locks, and release devices that interface with the fire alarm system.

1.3 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

A. The facility has an existing zoned fire alarm system, the control panel for which is an FCI model FC72. The system shall be expanded to control initiating devices, notification appliances, and other system components and features indicated on the drawings and specified herein. Provision of all common system components, power supplies, batteries, etc. required for a complete and operational system is included in the work of this section. Existing fire alarm components in areas not affected by the work of this project shall remain.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.

3. Smoke detectors.
4. Automatic sprinkler system water flow.

C. Fire alarm signal shall initiate the following actions:

1. Alarm notification appliances shall operate continuously.
2. Identify alarm at the FACP and remote annunciators.
3. De-energize electromagnetic door holders.
4. Transmit an alarm signal to the remote alarm receiving station.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
7. Close smoke dampers in air ducts of system serving zone where alarm was initiated.

D. Supervisory signal initiation shall be by one or more of the following devices or actions:

1. Operation of a fire-protection system valve tamper.

E. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Open circuits, shorts and grounds of wiring for initiating device and notification-appliance circuits.
2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at the FACP.
4. Ground or a single break in FACP internal circuits.
5. Abnormal ac voltage at the FACP.
6. A break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at the FACP or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

F. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire alarm system design.
b. Fire alarm certified by NICET, minimum Level III.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Device Address List: Coordinate with final system programming.

4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
6. Batteries: Size calculations.
7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Floor Plans: Indicate final outlet locations.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

    a. Hard copies on paper to Owner and authorities having jurisdiction.
    b. Electronic media may be provided to Architect.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level II.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without Owner's written permission.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
3. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. FACP and Equipment:

    a. Fire Control Instruments (FCI) to match existing.

2. Wire and Cable:

    a. Comtran Corporation.
    b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
    c. West Penn Wire/CDT; a division of Cable Design Technologies.

3. Audible and Visual Signals:

    a. Amseco; a division of Kobishi America, Inc.
    b. Commercial Products Group.
    c. Gentex Corporation.
    d. System Sensor; a GE-Honeywell Company.
    e. Wheelock, Inc.

2.2 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
    1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. .
    2. Station Reset: Key- or wrench-operated switch.

B. Compatible with existing control panel.

2.3 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

    1. Operating at 24-V dc, nominal.
    2. Detectors shall be two-wire type.
    3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
    4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
    5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
    6. Compatible with existing control panel.

B. Photoelectric Smoke Detectors: Comply with UL 268.

C. Duct Smoke Detectors:

    1. Photoelectric Smoke Detectors:

        a. Sensor: LED or infrared light source with matching silicon-cell receiver.
        b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

    2. UL 268A listed, operating at 24-V dc, nominal.
    3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

4. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.
6. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
7. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.4 HEAT DETECTORS

A. General: UL 521 listed.

1. Compatible with existing control panel.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.

2.5 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Compatible with existing control panel.

C. Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet (3 m) from the bell. 10-inch (254-mm) size, unless otherwise indicated. Bells are weatherproof where indicated.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.

E. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output: multiple, field-selectable candela ratings, set to value indicated on the drawings.
2. Strobe Leads: Factory connected to screw terminals.

2.6 SPRINKLER SYSTEM REMOTE INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.7 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as required for each door and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 24-V ac.

B. Material and Finish: Match door hardware.

2.8 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.9 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Circuits:
1. Initiating Device Circuits: NFPA 72, Class A, Style 6
2. Notification Appliance Circuits: NFPA 72, Class B, Style Y.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, UL listed

for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed the rating of the detector.
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

C. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install at 80" above finished floor or not less than 6 inches (150 mm) below the ceiling, whichever is lower. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at 80" above finished floor or not less than 6 inches (150 mm) below the ceiling, whichever is lower.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.

B. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes."

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is permitted where allowed by the authority having jurisdiction.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct

supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

a. Include the existing system in tests and inspections.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1.

END OF SECTION 16721

SECTION 17000 – TECHNOLOGY

PART 1 - GENERAL

1.1 BID FORMAT AND CONTENTS

A. The Project Approach section shall include a detailed discussion of the approach to the development and implementation. This section shall cover:
   1. Description of system components and specifications of all Included items.
   2. Methodology for installation and set-up of all components.

B. Anticipated Problem Areas and Assumptions
   1. Provide description of any problem areas in this project that the Offeror foresees or any unusual risks in the Offeror's Response. This section should also detail any assumptions that the Offeror has made about the project or the Owner's intentions in preparing its Response.

C. Universal Service Fund E-Rate Discounts
   1. The Contractor must be registered with the E-Rate Program.
   2. The Contractor shall comply with all requirements so that project is eligible for E-Rate funding.

1.2 WORK INCLUDED

A. Alternates: Refer to Section 01030 - Alternates to determine extent of, if any, work of this section that will be affected by any alternates if accepted.

B. Furnish and install all wiring, systems, equipment, and accessories in accordance with the specifications and drawings.

1.3 SYSTEM DESCRIPTION

A. Definitions:
   1. Listed: Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.
   2. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
   3. Certified: Equipment is "certified" if it meets the following:
      a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
      b. It bears a label, tag, or other record of certification.
   4. Nationally Recognized Testing Laboratory: A testing laboratory, which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

5. Where any device or part of equipment is referred to in these specifications in the singular number (such as the "switch"), such reference shall be deemed to as many such devices as are required to complete the installation as shown on the drawings.

1.4 QUALITY ASSURANCE

A. General: All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc. where such standards have been established. Equipment and material, which are not covered by UL Standards, will be accepted provided equipment and material is listed, labeled and certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class that no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered if inspected or tested in accordance with national industrial standards such as NEMA or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Products Criteria:
1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least five years prior to bid opening. Provide list of users upon request.
2. Equipment Service: Products shall be supported by a service organization, which maintains an adequate inventory of repair parts and is located, in the opinion of the Designer/Engineer, reasonably close to the site.
3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
5. Nameplates: Nameplate bearing manufacturer's name or identification trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
6. All factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

C. Protection of Equipment and Materials: Responsibility for care and protection of all materials and work rests with the Contractor at all times until the entire project has been completed, tested and the project is accepted.
1. Damaged equipment shall be placed in first class operating condition or be returned to the source of supply for repair or replacement, to the satisfaction of the Owner's Representative.
2. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.

D. Substitutions: Refer to Section 01605 - Products and Substitutions.

1.5 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
   1. National Fire Protection Association (NFPA).
   2. National Electrical Code (NEC)
   3. National Electrical Safety Code (NESC)
   4. Underwriters Laboratories, Inc. (UL)
   5. American National Standards Institute (ANSI)
   6. EIA/TIA
   7. National Electrical Manufacturers Association (NEMA)
   8. ADA
   9. Applicable standards for each particular component

1.6 SUBMITTALS

A. In accordance with Section 01340 - Submittals, furnish the following:
   1. Manufacturer's Literature and Data shall be submitted under the pertinent section (see individual sections) rather than under this section.
      a. Mark the submittals, "Submitted Under Division 17 - Technology".
      b. Submittals shall be marked to show specification reference including the section and paragraph numbers where applicable, and equipment identification number as shown on the drawings.
   2. The submittals shall include the following:
      a. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
      b. Elementary interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
      c. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
      d. Manuals:
         1) Maintenance manuals shall be complete and shall be furnished in a loose leaf binder or in the manufacturer's standard binder. Information shall be sufficient to enable a qualified technician to perform normal first line maintenance and repair.
         2) Operation manuals shall be clear and concise and shall describe, in detail, the information required for proper operation of the equipment specified.
      e. Approvals will be based on complete submission of manuals together with shop drawings. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Partial submittals for systems will not be considered for approval.

1.7 PROJECT CONDITIONS

A. Regulatory Requirements:
   1. Conform to the requirements of all laws and regulations applicable to the work.
   2. Cooperate with all authorities having jurisdiction.

3. Compliance with laws and regulations governing the work on this project does not relieve the Contractor from compliance with more restrictive requirements contained in these specifications.
4. If the Contract Documents are found to be at variance with any law or regulation, the Contractor shall notify the Designer/Engineer promptly in writing. The Contractor shall assume full responsibility for any work contrary to law or regulation, and shall bear all costs for the corrections thereof.

B. Permits, Fees, and Inspections:
1. Secure and pay for all permits, fees, licenses, inspections, etc., required for the work under Division 16.
2. Schedule and pay for all legally required inspections and cooperate with inspecting officers.
3. Provide Certificates of Inspection and Approval from all regulatory authorities having jurisdiction over the work in Division 17. Contact the electrical inspectors office and the Fire Marshall for the area where the work is being performed to be sure you have met all local requirements.

C. Drawings:
1. Do not scale the drawings. The general location of the apparatus and the details of the work are shown on the drawings, which form a part of this specification. Exact locations are to be determined at the building as the work progresses, and shall be subject to the Designer/Engineer's approval. Actual field conditions shall govern all dimensions.
2. Anything shown on the drawings and not mentioned in the specifications or vice versa shall be furnished as if it were both shown and specified.
3. It is not intended that the drawings shall show every wire, device, fitting, conduit or appliance, but it shall be a requirement to furnish without additional expense, all material and labor necessary to complete the systems in accordance with the NEC and the best practice of the trade.

D. WARRANTY
1. Guarantee: The guarantee required in Division 1 shall apply except as made more restrictive for specific items hereinafter specified.

1.8 SERVICE QUALIFICATIONS

A. There shall be a permanent service organization maintained or trained by the manufacturer, which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

PART 2: PRODUCTS - NOT USED

PART 3: EXECUTION

1.9 3.1 INSTALLATION

A. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Designer/Engineer prior to installation. Installation of the item will not be allowed to proceed

until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

B. Coordinate location of equipment and conduit to abide by all codes and intent of drawings and specifications with best practices of the trade.

C. Protection: During installation, equipment, controls, controllers, circuit protection devices, etc., shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing, operating and painting.

D. Equipment location shall be as close as practical to locations shown on the drawings.

E. Inaccessible Equipment:
1. Where the Designer/Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and ductwork.

F. Equipment Identification:
1. In addition to the requirements of the National Electrical Code, install an identification nameplate which will clearly indicate information required for use and maintenance of items such as cabinets, control devices and other significant equipment.

G. Painting: Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious. The paint on all cabinets and enclosures shall be restored by complete repainting if necessary because of damage to exterior finishes. All exposed conduit shall be painted in finished spaces(Note that all conduit shall be concealed unless noted otherwise).

H. Provide sleeved penetrations as required for all cabling, wiring, devices, etc.

I. Wiring or cabling shall be run concealed in walls or above ceiling. Where cabling is to be surface mounted (where noted to be allowed on drawings), it is to be mounted in conduit. All conduit shall be provided by Division 16.

J. Record Drawings: The Contractor shall keep on the job a set of blue-line prints, marked up to show any changes to the installation neatly marked in red ink. These shall be given to the Designer/Engineer at the completion of the work, prior to final acceptance.

END OF SECTION 17000

SECTION 17100 – CABLE PLANT

PART 1 - GENERAL REQUIREMENTS

1.1 Experience

A. The selected Contractor shall be fully capable, certified, and experienced in the installation of telecommunications distribution systems.

B. Codes, Standards, and Ordinances: It is the contractors responsibility to be sure the installation complies with all below and must be aware of all codes and standards that may impact this project.
   1. All work shall conform to the latest edition of the National Electrical Code, the Building Code, and all local codes and ordinances, as applicable.
   2. In addition to the following applicable standards listed below this installation shall comply with any new standards recently approved and all other approved telecommunications standards.
      a. ANSI/TIA/EIA-568-B.1
      b. ANSI/TIA/EIA-568-B.2
      c. TIA/EIA-568-B.2-1
      d. ANSI/TIA/EIA-568-B.3
      e. TIA/EIA 568-B.3-1
      f. ANSI/TIA/EIA-569-A
      g. ANSI/TIA/EIA-569-A.1
      h. ANSI/TIA/EIA-569-A.2
      i. ANSI/TIA/EIA-569-A.3
      j. ANSI/TIA/EIA-569-A.4
      k. ANSI/TIA/EIA-606
      l. ANSI/TIA/EIA-607
      m. ANSI/ICEA S-90-661
      n. ANSI/TIA/EIA-492-AAAA
      o. ANSI/TIA/EIA-472-CAAA
      p. ANSI/TIA/EIA-472-DAAA
      q. ANSI/TIA/EIA-598
      r. ANSI/TIA/EIA-455
      s. ANSI/TIA/EIA-604
      t. ANSI/ICEA S-80-576
      u. ANSI/ICEA S-83-596
      v. ANSI/ICEA S-83-640
      w. TIA/EIA TSB67
      x. TIA/EIA TSB72
      y. TIA/EIA TSB75
      z. TIA/EIA TSB95
      aa. ISO/IEC 11801
      bb. ISO/IEC JTC 1/SC 25/WG 3 N655
      cc. CENELEC EN50173
      dd. IEC 603-7

C. Provide installer-training certificates from the manufacturer of the products to be installed for the technicians who will be performing the installation, terminating and testing.

D. Structured Cabling System Warranty: Provide certificates and manufacturer documentation that the materials and labor will qualify and will be warranted for a minimum of fifteen years. This minimum fifteen-year warranty applies to both the optical fiber and copper cabling systems.
   1. The owner will be provided with all information on the terms and conditions of the warranty. The installing contractor shall explain the warranty in detail to the owner.
   2. System acceptance will not begin until this documentation is received.
   3. All warranty information shall be provided with the bid submittal.
   4. Provide details on any additional warranty coverage that will be provided or that is available.
   5. Clearly present what warranty coverage is provided with your bid and if any additional warranties are available but not included. Clearly detailed the additional warranty, that it is not included and the terms and conditions.
   6. Provide a list with the bid of any materials that will not be included in the warranty.
   7. The installation shall meet all requirements of the manufacturers warranty.

1.2 Firestopping

A. General
   1. All requirements for fire-stopping in division 1 shall be met in addition to the following.
   2. Telecommunications cables and cable paths penetrating non-rated and fire-rated floors, walls, and other partitions of building construction shall be sleeved and fire-stopped where they penetrate building construction. The structure will be returned to its intended and original fire rating.
   3. Fire-stopping shall be accomplished by using a combination of materials and devices, including penetrating raceway, putty's and caulk required to make up a complete fire-stop system.
   4. Verify that cabling and other penetrating elements and supporting devices have been completely installed and temporary lines and cables have been removed.
   5. All fire-stopping shall be performed using UL® approved methods. Provide the system number for each fire-stop system to be used.
   6. All telecommunications through-wall and through-floor penetrations shall be identified on the as-built documentation. The fire-stop system number for all penetrations shall be part of the identification.
   7. All penetrations made in the main cable path (corridors, hallways, Telecommunications Room) shall be four-inch sleeve minimum. Multiple sleeves shall be installed as needed to support the number of cables being installed and for the fire-stop system being used. Provide 50% future capacity on all sleeves for data cable paths and 20% on all others. A sleeve shall be installed for each system as detailed in the main cable paths.
   8. A minimum of a two-inch sleeve shall be installed to each classroom and a minimum of a one-inch sleeve to each office. Size the sleeve for the number of cables and the fire-stop system being used. All telecommunications cabling shall use these sleeves to access the classrooms and offices.

1.3 General

A. Section Includes: Equipment, materials, labor, and services to provide telephone and data distribution system including, but not limited to:
   1. Cable pathways (including through-wall and through floor penetrations, excluding conduit, conduit by division 16)
   2. Copper cabling and terminations.
   3. Optical fiber and terminations.

4. Telecommunications outlets.
5. Termination blocks.
6. Equipment racks and cabinets.
7. System testing.
8. Documentation and submissions.

B. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete all parts of the installation. Ensure that they are in compliance with requirements stated or reasonably implied by the contract documents.

C. Work not included:
1. Off-site services.
2. Providing network electronics, servers, computers, and other active devices.

D. Specific outlets and connections needed:

1. 2 phone lines from the telephone demarc to the fire alarm control panel

2. 1 data line and 1 phone line connected from the telephone demarc to the security panel

3. 1 phone line connected from the telephone demarc to the utility meter per CMP requirements

4. 1 phone line connected from the telephone demarc to the elevator communication system

5. Provide additional outlets as indicated in specifications and drawings.

E. Where materials, equipment, apparatus, or other products are specified by manufacturer, brand name, type or catalog number, such designation is only to establish standards of performance, quality, type and style, unless such designation is identified as proprietary.

F. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the owner's representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

1.5 Submittals

A. Submit to the engineer shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with your bid submittal. The engineer will indicate approval of shop drawings, product data, and samples submitted to the engineer by stamping such submittals "APPROVED" with a stamp. Submitted shop drawings shall be initialed or signed by the contractor, showing the date and the contractor's legitimate firm name.
1. By submitting shop drawings, product data, and samples, the contractor represents that he or she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the contractor has checked, coordinated, and verified that information contained within shop drawings, and product data conform to the requirements of the work and of the contract documents.

2. The engineer's approval of shop drawings, product data, and samples submitted by the contractor shall not relieve the contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed the engineer in writing of such deviation at time of submittal, and the engineer has given written approval of the specific deviation. The contractor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the contractor in writing, and specifically approved by the engineer in writing.

B. Perform no portion of the work requiring submittal and review of shop drawings, or product data until the engineer has approved the respective submittal. Such work shall be in accordance with approved submittals.

C. Provide additional requirements per Section 01300 - Submittals.

D. Shop drawings: Submit the following:
1. System block diagram, indicating interconnection between system components and subsystems.
2. Interface requirements, including connector types and pin-outs, to external systems and systems or components not supplied by the contractor.
3. Submit cable schedules for each cable by system. Use the cable form included in Section 3.

E. Product Data: Provide catalog cut sheets and information for the following. Include only information on the products to be used. Include quantities, part numbers and descriptions with bid submittal.
1. Copper cables and optical fiber cables.
2. Outlet modules, faceplates and bulkheads. Assemble one of each type of faceplate to be installed and provide with a sample of the labeling to be used.
3. Terminal blocks and/or patch panels.
4. Enclosures, racks, and equipment housings.
5. Fire-stop systems.
6. Testing equipment to be used

F. Quality Assurance
1. The contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.
2. Furnish a list of references with specific information regarding type of project and involvement in providing materials, installation and project management. Provide references of projects of similar size and scope.
3. Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.
4. Where equipment and materials have industry certification, labels, or standards (i.e., NEMA - National Electrical Manufacturers Association), this equipment shall be labeled as certified or complying with standards.
5. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout unless pre-approved.
6. Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the owner and engineer. Any and all sub-contractors shall be identified in the bid submittal.

1.6 Warranty

A. Unless otherwise specified, unconditionally guarantee in writing all the materials, equipment, and workmanship for a period of not less than one (1) year from date of acceptance by the owner in addition to the minimum 15 year system warranty. Acceptance shall be deemed as beneficial use by the owner.

B. Transfer manufacturer's warranties to the owner in addition to the General System Guarantee. Provide all warranty information with bid submittal. It is the installing contractors responsibility to be sure that all the criteria is met to be eligible for the manufactures warranty. Submit additional available warranties for each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty.

C. All proprietary equipment and systems involved in this contract shall be warranted during the guarantee period. Final payment shall not relieve you of these obligations.

PART 2 - PRODUCTS

2.1 Approved Manufacturers and Products

A. Manufacturers
1. All faceplates, consolidation points, connector modules, patch panels, termination blocks, bulkheads, horizontal cable management and cable shall all be from the same manufacturer. Cable from a different manufacturer than that of the connectivity manufacturer or a combination of manufacturers must be pre-approved and must have a warranty program to cover the proposed combination solution.

B. Wall plates: Provide flush mount electrical ivory wall plates at all locations.
1. All wall plates shall have a top and bottom clear plastic label holders for the identification of all outlet locations. All locations shall be machine labeled.
2. Provide six position wall plates for all single gang box locations use blank fitting for all unused positions. Provide twelve position wall plates for all double gang box locations use blank fitting for all unused positions.
3. Weatherproof covers for exterior data outlets shall consist of outlets as specified, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Covers shall be in use style Hubell WP26M series. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 UNSHIELDED TWISTED PAIR (UTP) CABLING SYSTEMS

G. Manufacturer: Provide products meeting the requirements of the Drawings and Specifications from one of the following manufacturer's:

Wire and Cable:	AT&T, Belden, Berk-Tek, CommScope, General Cable, Mohawk, Prestolite, Superior or approved equal.

Modular Jacks:	Shall be provided by the Work Area Outlet Manufacturer.
Patch Panels:	AT&T, Amp, Hubbell, Krone, Ortronics, Panduit, Siemon, or approved equal.
Patch Cables:	Shall be provided by patch panel, Work Area Outlet or wire and cable manufacturer.
Cable Management:	Shall be provided by patch panel manufacturer.

NOTE: Each of the products listed above shall be provided by a single manufacturer.

Voice/Phone Punch Block::	AT&T, Hubbell, Siemon, or approved equal.

H. UTP Pin/pair Termination Assignment:The UTP cabling systems shall have EIA/TIA 568B Series standard pin/pair termination assignment. All conductors provided shall be properly and consistently terminated at both ends throughout the entire systems.

I. Horizontal Cable -Voice & Data
1. Voice & Data Cable shall be TIA/EIA Category 6 Unshielded Twisted Pair (UTP) cable, General Cable GENSPEED 6000
2.
3. Non-plenum rated cable - CM rated jacket for Non-plenum applications.
4. Riser rated cable - CMR rated jacket for Riser applications.

J. Intra building Backbone Cable - Voice (Category 6)
1. TIA/EIA Category 6 Unshielded Twisted Pair (UTP)
2. Cable shall meet or exceed all current draft specifications for Category 6cable per EIA/TIA 568B Series standard 24 AWG, twenty-five pair cable.
3. Backbone cable shall match-up all pairs (4-pairs from each work area outlet) to the MDF/IDF.
4. Non-plenum rated cable - CM rated jacket for Non-plenum applications.
5. Riser rated cable - CMR rated jacket for Riser applications.
6. This cable shall be terminated on 110-RJ45 Category 6 blocks, Siemon S110AB5-300JP 36 Port units.
7. Provide voice backbone between the MDF and each IDF and as shown on plans.

K. Outside Telephone Line Interface Cable, two (2) 50 pair cables -Voice & Data (Category 6)
1. TIA/EIA Category 6 Unshielded Twisted Pair (UTP)
2. Cable shall meet or exceed all current specifications for Category 6 cable per EIA/TIA 24 AWG, twenty-five pair cable.
3. Non-plenum rated cable - CM rated jacket for Non-plenum applications.
4. Riser rated cable - CMR rated jacket for Riser applications.
5. Provide & terminate cables from service entrance location to MDF for interface to Voice and/or Data systems.
6. Provide & terminate the Category 6 data cabling from the MDF to applicable data equipment head end rack location.

7. Terminate the cable at the MDF on the same type termination hardware as the voice risers.

L. TI Cable -Voice & Data

1. Provide two (2) T1 specific cables (1-Voice & 1-Data) from Service Entrance location to MDF for interface to Voice and Data systems.
2. Cable shall meet or exceed specifications for Lucent T1 Cable #107503583, designed specifically for T1 Transmissions.
3. Non-plenum rated cable - CM rated jacket for Non-plenum applications.
4. Plenum rated cable - CMP rated jacket for Plenum applications.
5. Riser rated cable - CMR rated jacket for Riser applications.
6. Provide & terminate cabling from the MDF to applicable network voice and data equipment head end rack locations.

M. Cable Management

1. Each equipment rack and equipment cabinet shall have cable management panels with horizontal and vertical brackets.
2. Cable management shall be EIA nineteen inch (518mm) rack mounted 3.5 inch (88mm) high panel with horizontal and vertical patch cable, distribution rings, or approved equivalent and shall be provided above and below each patch panel in the equipment rack.
3. Equipment rack cable management shall be furnished by patch panel manufacturer.
4. Cable management for high density, IDC Type cross-connect block panels shall be distribution rings integral to the panel or approved equivalent. Cable management shall be provided above and below each cross connect block in the equipment rack.

N. Modular Jacks (Work Area Outlets)

1. Jacks shall be RJ-45 TIA/EIA Category 6 (UL Category 6) with printed circuit board technology and integral board mounted, color-coded, high density, IDC type terminations. Provide 8 position modular jacks. Keyed jacks are not allowed. Jacks shall be able to withstand at least a minimum of 2000 mating cycles without any transmission degradation.
2. Modular jacks color shall match Work Area Outlet faceplate.
3. Each Work Area Outlet and modular jack shall have jack opening dust cover. Modular jacks that do not have integral dust covers shall have dust covers installed on each unused modular jack.
4. Each 8-position modular jack shall have color-coded icons.
5. Modular jacks that allow preconnectorized cables to be connected to the jacks are specifically prohibited. Cables shall have single point IDC Type connection to the jacks only.
6. Modular jacks for Work Area Outlets shall be integral to a jack module either having one or two jacks per module. Single jacks shall be located in the center of the module while double jacks shall be side-by-side horizontally. Jack modules with a single jack and a blank in the opening where a second jack would normally be located are specifically prohibited.
7. Jack modules shall be flame retardant thermoplastic with integral cable strain relief.

O. Voice and Data Patch Panels

1. Patch panels shall be EIA nineteen inch (518mm), rack mounted, TIA/EIA Category 6, UL Category 6 type patch panels with integral printed circuit board, color-coded, high density, IDC type terminations and 8 position modular jacks. Keyed jacks are not allowed. Jacks shall be able to withstand at least a minimum of 2000 mating cycles without any transmission degradation.
2. Provide high density rack mounted patch panels.
3. Modular Jacks that allow pre-connectorized cables to be connected to the jacks are specifically prohibited. Cables shall have single point IDC type connection to the jacks only.
4. Each port shall have color-coded identification label. Continuous label strips for multiple in-line ports are acceptable. Silk screened identifiers "1" through "96" are acceptable.
5. Patch panel shall have horizontal strain relief bar on mounted rear.

P. Patch Cables and Line Cords
1. Patch cables and line cords shall be factory pre-connectorized, TlA/EIA Category 6 (UL Category 6), 4 UTP, 8-position modular jack, stranded conductors. Patch cables and line cords shall be able to withstand at least a minimum of 2000 jack mating cycles without any transmission degradation.

Q. Cross Connect Blocks – Voice Backbone Category 6:
1. Cross-connect blocks shall be TIA/EIA Category 6 (UL Category 6) color-coded, high density, IDC type terminations, 100 pair, cross connect blocks. Type 66 IDC cross connect blocks or similar are not allowed. Cross-connect blocks shall have integral stand-off brackets.
2. Modular connectors that allow preconnectorized cables to be connected to the cross connect blocks are specifically prohibited. Cables shall have single point IDC type connection to the cross-connect blocks only.
3. Each (4 pair) connection shall have a color-coded identification label. Continuous label strips for multiple in-line terminations are acceptable.
4. Provide with horizontal and vertical cable management.

R. Cross Connect Cabling
1. Cross-connect cabling shall be NRTL certified that it meets or exceeds the TIA/EIA UL category rating of the system installed.
2. Specific phone lines required: Provide the following phone lines from the telephone demarc to the following locations:
   a. The building electrical meter
   b. The security panel
   c. The Fire alarm control panel – Provide 2 lines
   d. The elevator
   e. Additional lines indicated on plans and specs

1.2 FIBER OPTIC CABLING SYSTEMS - Data

A. Provide products meeting the requirements of the Drawings and Specifications from one of the following Manufacturers:

Cable:	Avaya, Berk-Tek, CommScope, Corning, General Photonics, Krone, Optical Cable Corp, Prestolite, or approved equal. NOTE: Cabling installed in underground conduits shall be OSP gel-filled or OFNR Indoor/Outdoor Rated cables.
Connectors and Couplers:	3M, Avaya, Krone, Corning, or approved equal.
Innerduct::	George-Ingraham, Carion, Pyramid Industries, or approved equal.
Patch Panels:	Avaya, Krone, Lucent Ortronics, Siemon, Coring, or approved equal.
Patch Cables:	Shall be provided by fiber optic patch panel or cable manufacturer.
Cable Management:	Shall be provided by fiber optic patch panel manufacturer.

B. Intra building Fiber Optic Backbone Cable
   1. Multimode fiber optic cable:
      a. Cable shall be certified to TIA/EIA 492CAAA, 492AAAB ANSI/TIA/EIA 568B Series standard, and ISO/IEC 11801 fiber optic specifications, 50/125 micron, 850/1300 nm, graded video, dual window 6 pair (12 strands) tight buffer, multimode distribution cable.
         1) Riser-rated multimode cable - OFNR jacket, distribution cable for Riser applications.
         2) The maximum attenuation measured at 23 degrees C. shall be 2.5 dB/km @ 850 nm and 0.7 dB/km @ 1300 nm. The minimum bandwidth shall be 500 MHZ @ 850 nm and 500 MHZ @ 1300 nm.
      b. Provide fiber optic backbone cable between each data MDF and IDF.
   2. All backbone fiber optic cables shall be installed in a flexible plastic conduit (inner-duct). One and a half inch inner-duct shall be installed from equipment rack to equipment rack in a complete system for all backbone fiber optic cables. All inner-duct shall be securely fastened and supported by J hooks or cable runway. No changes in direction will be allowed in pull boxes. All connections to junction or outlets boxes shall be done with a squeeze-type flexible conduit connector with locknut and a plastic bushing. All inner-duct will be securely fastened within six inches from each end.

   3. All inner-ducts shall be labeled with a self-laminating label with the origin room name and number – destination room name and number - Number of strands and type of cable for each cable in the duct being labeled. Labels shall be installed at each end and on each side of any penetrations. Labels shall be located so they can be easily spotted and read.

   4. Provide a minimum of ten feet of service slack for each cable at each end.

5. All inner-duct shall be left with a pull string installed from end to end at completion of the project.

C. Modular Connectors and Couplers
1. Fiber optic modular connectors/couplings shall be NRTL listed and TIA/EIA compliant, type "SC" terminations. Connectors and couplings shall be able to withstand at least a minimum of 2000 mating cycles without any transmission degradation. Maximum optical loss budget shall not exceed .75 dB per termination and 1.5 dB per mated pair.
2. The connectors and couplings shall be compatible with the installed fiber optics: multimode 50.5/125 micron optics.
3. Fiber optic connectors shall be terminated by the following methods:
   a. Hot Melt
   b. Heat Cured Epoxy
   c. Ultra Violet Cured Epoxy
   d. Anarobic
   e. Mechanical Splice with Index Matching Gel
4. Fiber optic connectors and couplers shall be provided by a single Manufacturer.
5. Multimode and single mode connectors shall be different in color.

D. Fiber Optic Patch Panels
1. Patch panels shall be capable of terminating all strands of the fiber optic cables installed in an IDF or the MDF.
2. Patch panels shall be rack mounted 1.75 inch (44mm) high EIA nineteen inch (518mm) wide, rack mounted, drawer type with integral cable management, patch panels pre-loaded with duplex SC couplings.

E. Fiber Optic Patch Cables
1. Provide NRTL certified EIA/TIA 492AAAA, EIA/TIA 568B Series standard performance tested patch cables as required for a complete operational system. Patch cables shall be factory preconnectorized, two strand, "SC" type connectors, tight buffer. Patch cables connectors shall be provided by the same manufacturers as the fiber optic connectors and couplings.
2. Patch cables shall match the fiber optic system installed, multimode 50.5/125 micron. One strand of the patch cable shall have a distinguishing mark throughout its entire length to simplify the distinction between Transmitting (Tx) and Receiving (Rx) at the patching area. Color coded factory marked (Tx-Rx) connectors are preferred.

F. Fiber Optic Cable Management
1. Each equipment rack shall have horizontal and vertical cable management panels and brackets.
   a. Horizontal cable management shall be EIA nineteen inch (482mm) rack mounted 1.75 inch (44mm) high drawer panel with integral cable management and shall be provided for each fiber optic patch panel. This cable management drawer panel is for the fiber optic patch cables and is separate from the fiber optic patch panel drawer.

1.3 BROADBAND RF CABLING SYSTEMS

A. Manufacturer: Provide products meeting the requirements of the Drawings and Specifications from one of the following:

Wire and Cable:	Avaya, CommScope, Belden, Ber-Tek, General Cable or approved equal.
Connector Modules:	Shall be provided by manufacturer of UTP Work Area Outlets.
Broadband Connector:	Amp, Amphenol, Cambridge, Regal, Gilbert.
Line Cords:	CommScope, Lucent Technologies, AT&T, Berk-Tek, General Cable, Champlain, or approved equal.
Splitting Devices:	Blonder-tongue, General Instruments/Jerrold, Regal, or approved equal.

B. All required components shall be provided for the reception and distribution of signal for all rooms equipped with outlets.

C. The system including all of its components shall be broadcast quality and shall provide for reception of monochrome (black and white) and color TV transmission and FM (at every outlet) equal to or superior to that obtainable on a single standard receiver connected directly to the system antennas (CATV).

D. The system design minimum shall be a 43 dB carrier-to-noise ratio and minus 46 dB (0.5%) cross-modulation level at output of the last amplifier in the distribution system.

E. The system shall be designed so subsequent expansion to additional VHF of UHF channels shall require modifications of head-end equipment only.

F. All active equipment shall be designed and rated for 110V to 125V, 60 Hz, AC operation and shall be NRTL listed.

G. The system shall provide for distribution of up to 100 + television channels from a feed provided by a CATV Company or satellite dish.

H. The system shall meet or exceed the technical standards set forth in the FCC Rules, Part 76.

I. The system shall also be capable of providing two-way communication (Bi-directional video distribution) over a single cable.

J. Bandwidth of all passive devices shall be from 5 MHZ to 1.2 GHz. Bandwidth of amplifiers shall be from 54 MHZ to 1 GHz in the forward direction and from 5 MHZ to 30 MHZ in the reverse path.

K. The system shall be designed for minus 57 dB cross-modulation or greater and carrier-to-noise ratio of at least 46 dB.

L. The broadband RF cable shall be coaxial copper-clad center conductor, foam polyethylene dielectric, quad-shield aluminum-mylar-aluminum foil type, aluminum braid shield and non-contaminating polyvinyl chloride jacket. Cable shall have 75 ohm impedance with 80 dB shielding. No discontinuity shall exist within 54-216 MHZ and 470-890 MHZ bands. Cable shall be used as follows:

M. Hardline Backbone cable shall be equivalent to CommScope #T3JCAP Hardline Coax Cable for Plenum-Rated areas and #T3JCAR Coax Cable for Non-Plenum Rated areas.

N. The Hardline trunk/backbone cable shall be home run directly to video head end location. If field amplification is required to increase db levels, the amplification hardware must be installed in all applicable IDFs and MDFs.

O. Backbone cable shall meet or exceed the following nominal attenuation specifications and shall not exceed 1000 feet from head end:

5mhz	.13db/100'
30mh	.34 db/100'
50mhz	.43 db/100'
108mhz	.63 db/100'
220mhz	.93 db/100'
400mhz	1.26 db/100'
750mhz	1.8 db/100'
865mhz	1.90 db/100'
1000mhz	2.10 db/100'

P. Drop Cable, shall be equivalent to CommScope RG-6/U, utilize quad-shielding.
1. Non-Plenum Rated Cable: #5740 CM rated jacket for Non-plenum applications.
2. Drop Cable shall meet or exceed the following nominal attenuation specifications and shall not exceed 100 feet to tap on A/V Distribution Trunk/Backbone cable:

1mhz	.21db/100'
10mhz	.65 db/100'
50mhz	1.46 db/100'
100mhz	2.04 db/100'
200mhz	2.98 db/100'
400mhz	4.46 db/100'
700mhz	5.89 db/100'
900mhz	7.47 db/100'
1000mhz	8.02 db/100'

Q. Broadband CATV Cable - Provide Hardline cable equivalent to CommScope #QR 540 Hardline Coax Cable.

R. Provide cable from Entrance Protection/Demarcation location to MDF for interface to Broadband Video Distribution System.

S. Provide cable from MDF to Broadband Video Distribution System Head end location.

T. Signal Level, calculated and tested signal level shall fall between +2dBmv and +11dBmv. Submit signal level test results to specifying authority for approval. Channel to Channel differential shall not exceed 2dB nor shall it exceed 10dB from 50 MHZ to 550 MHZ.

U. Broadband Connector Modules
1. Broad band connectors for work area outlets shall be integral to a connector module either having one or two connectors per module. Single connectors shall be located in the center of the module while double jacks shall be located side by side horizontally.
2. Connector modules shall be high impact, flame-retardant thermoplastic with RF type connectors. Modules shall be interchangeable with UTP cabling jack modules.
3. Refer to Work Area Outlets, section for connector modules.

V. Broad Band Connectors
1. Refer to Work Area Outlets, section for termination/connector type.
2. Connector type shall be compatible with cable type.
3. Connector types: 75 ohm with hexagonal 3/4 inch compression termination.

W. Line Cords
1. Each work area outlet shall be provided with a line cord, field measured for proper length, which meets the following:
2. Line cords shall be Type 6U, quad shielded, stranded, (extra flexible), copper-clad core cable with an "F" type connector with solid center conductor terminated on both ends.

X. Broadband Cabling Splitting Devices
1. Broadband tap/splitting devices shall be used in the system as required to meet specified signal strength at each jack location. These units shall utilize a die cast housing and RF shielding exceeding local cable company requirements (minimum -80dB) and be equipped with flanges to permit mounting on any flat surface and shall meet FCC specifications on radiation.
2. Passive Splitters shall have a rated frequency range of 5-1000 Hz and shall be equivalent to Blonder Tongue XRS series. .
3. Two-way splitters shall have a maximum splitting loss of 3.8 dB. Four-way splitters shall have a maximum splitting loss of 8.4 dB. Directional couplers shall be available in nominal tap loss values of 8, 12, and 16 dB and the return loss of any terminal shall be 18 dB or higher.
4. Terminating Resistor: Terminating resistors with 75 ohm impedance shall be installed at unused ports and feeder line ends. Terminating resistors shall be designed to cover the frequency range from 5 MHZ to 890 MHZ with minimum return loss of 25 dB at UHF and 30 dB across the VHF band.
5. Directional Coupler Tap, Flush Mounted: Directional coupler type taps shall be provided as required for signal distribution. The taps shall be fully shielded and in compliance with FCC rules pertaining to radiation. The taps shall be available in isolation values of

3, 8, 12, 16, 20, and 24 dB. Frequency response through any port shall be from 5 MHZ to 890 MHZ.

6. The directional coupler taps shall provide a single RF outlet with a type "F" connector. A through match shall be 18 dB minimum and back match shall be in excess of 14 dB. Any combination of taps shall provide a minimum isolation between tap ports of 30 dB. Through connection to the tap shall be made by standard type "F" fittings. The tap shall be housed in a rugged cast aluminum case and shall be above first floor lay-in ceilings.
7. Directional Coupler Multi-Tap, Surface Mounted: Eight-way directional couple-type taps shall be provided as required for signal distribution. The taps shall be fully shielded and in compliance with FCC rules pertaining to radiation. All connections to the unit shall be by standard type "F" connectors. The taps shall be available in isolation value of 20 dB.
8. The frequency response shall be from 12 MHZ to 890 MHZ and the return loss at any port shall be no less than 14 dB. Isolation between any two tap outlets shall be no less than 30 dB from 5 MHZ to 400 MHZ and no less than 15 dB from 470 MHZ to 806 MHZ.
9. The tap shall be housed in a rugged cast aluminum housing provided with flanges to permit mounting on any flat surface.

2.4 S-VIDEO CABLING SYSTEM

Y. Provide products meeting the requirements of the Drawings and Specifications from one of the following:

S-Video Cable:	Cables-to-Go, L-COM, Technical Necessities, or approved equal
S-Video Coupler Modules:	Shall be provided by manufacturer of UTP Work Area Outlets.
S-Video Couplers:	Cables-to-Go, L-COM, Technical Necessities, or approved equal
S-Video Line Cords:	Cables-to-Go, L-COM, Technical Necessities, or approved equal

Z. Cable shall be 75 ohm S-Video coaxial type with factory pre-terminated ends. Field measure cable lengths before ordering from manufacturer for accurate length of cable to be installed in conduit, or Category 6 UTP cable if supported by the manufacturer of the S-Video module.

AA. Coupler modules shall be female/female, four pin mini-DIN S-Video type.

BB. Connectors shall be factory terminated on the cable and line cords. Connectors shall be male, four pin mini-DIN S-Video type.

CC. Each work area outlet shall be provided with a line cord, field measured for proper length, which meets the following:

DD. Line cords shall be 75 ohm, S-Video coaxial stranded type with factory pre-terminated ends.

1.4 AUDIO/VIDEO OUTLETS AND PATCH CABLING SYSTEM

A. Provide products meeting the requirements of the Drawings and Specifications from one of the following:

Cable:	Cables-to-Go, L-COM, Technical Necessities, or approved equal
Jack Modules:	Shall be provided by the work area outlet manufacturer
Couplers:	Cables-to-Go, L-COM, Technical Necessities, or approved equal
Line Cords:	Cables-to-Go, L-COM, Technical Necessities or approved equal

B. RCA audio/video cabling:
1. Patch cables shall be 6' stranded, 18 awg, shielded cable designed specifically for audio/visual distribution with manufacturer pre-connectorized ends (Male) Jacks shall be color coded(white, red, yellow) and interface to female/female, gold plated RCA type coupler modules. Jacks shall be able to withstand at least a minimum of 2000 mating cycles without any transmission degradation.
2. Between jack (within conduit) cabling shall be stranded, 18 awg, shielded cable designed specifically for audio/visual distribution, interfaced to applicable RCA jack modules.

C. Modular RCA Jacks (Work Area Outlets)
1. Jacks shall be color coded (white, red, yellow), female/female, gold plated RCA type coupler modules. Jacks shall be able to withstand at least a minimum of 2000 mating cycles without any transmission degradation.
2. Jack modules color shall match work area outlet faceplates.
3. Jack modules shall be flame retardant thermoplastic with integral cable strain relief. Color shall match faceplate.

1.5 VGA OUTLETS AND CABLE

A. Provide products meeting the requirements of the Drawings and Specifications as follows:

Cable:	L-COM part # CTBL3VGAMM xxT, or approved equal
Jack Modules:	Shall be provided by the cable manufacturer
Couplers:	L-COM part # DGBH15MF, or approved equal
Line Cords:	L-COM, or approved equal

B. VGA video cabling: Provide at all applicable locations. VGA cable shall be equivalent to L-COM # CTB3VGAMM-xxT. The VGA cable shall have three (3) 75 ohm coaxial lines.
1. Conductor: 32 AWG Tinned Wire Stranded
2. Insulator: Foam PE

3. Shield 1: Spiral tinned Copper Wire
4. Conductor Resistance: 588 ohms/km Max at 20 Deg C
5. Dielectric Test: 500 VAC 1 min
6. Impedance: 75 ±10 ohms
7. The VGA cable shall have nine (9) 30 AWG copper conductors.
8. Conductor: 30 AWG 7-strand Tinned Copper Wire
9. Insulator: Polypropylene
10. Conductor Resistance: 376 ohms/km Max at 20 Deg C
11. Dielectric Test: 500 VAC 1 min
12. The VGA cable shall have an outer aluminized Mylar shield, and tinned copper braid and drain wire.
13. The VGA cable shall have two (2) 15-pin molded housing connectors (P1 and P2), and two (2) 16-pin low profile, .079" (2mm) pitch disconnect connectors (P3-male, J1-Female).

C. VGA cables lengths shall be field measured.

D. Coupler shall be equivalent to L-COM part # DGBH15MF.

E. Patch cables and line cords.
1. Patch cables and line cords shall be HD15 male to HD 15 female, equivalent to L-COM # CTL3VGAMF-xxB.
2. Patch cable lengths shall be field measured.

2.5 Outdoor cable surge and lighting protection

A. All UTP cables run from the head end to IDF closets through underground conduits shall be gel filled OSP rated cables with each conductor protected on both ends by lightning/surge protectors. Lightning/surge protectors shall be equivalent Citel 280T series.

B. Manufacturer.
1. CITEL
1515 N W 167th Street - Suite 5-223
Miami, FL 33169
TEL: 800-248-3548 / 305-621-0022

C. Category 5 Surge Protection.
1. Citel part # 280T series, B25QC66 Base, or approved equal.
a. Cable Capacity: 25 pairs.
b. Connector type: QC66.
c. Module Capacity: 13.
d. Resistance: 47Ω.
e. Capacitance: 70 pF.
f. Maximum Line Current: 200 mA
g. Clamping Voltage: 190V
h. Power Handling:
8/20 µs 10 x's: 10 kA
8/20 µs 1 x's: 20 kA

1) include; a back-lit digital readout which displays the time; a monitor speaker which permits these audio programs to be monitored before they are

transmitted to classrooms or other locations; and a 4 - position monitor switch offering the follow selections: send program; send/monitor program; monitor program only, and "OFF" position.

2) A dedicated roof mounted twin dipole omni directional FM Antenna shall be provided. Two 1/2 wave dipole elements mounted 90 degrees to one another on the antenna mast give this antenna an omni-directional reception pattern. The antenna shall be supplied with the following accessories: connector cable, an 18" boom, vertical mounting bracket and horizontal mounting

2.4 Cable Paths

A. All cabling shall be supported using cable tray and J hooks. Cables shall not be supported by any other devices or the building structure. Secure the cable tray and J hooks to the structure using fasteners approved for the purpose and for the materials being fastened to. Provide cable tray from Chatsworth or approved equal and J hooks and assembly materials from Erico or an approved equal.

B. All main cable paths shall be installed in corridors and hallways and be completely accessible after completion of the project. No cable paths shall be installed through any rooms.

C. Provide a separate cable path for each systems cabling for all main cable paths sized as specified.

D. Provide all clearances as required by the codes and standards for the cabling being installed.

E. Provide cable tray or J hooks in all rooms, corridors and areas to be cabled.

2.5 Miscellaneous

A. Provide all equipment and accessories, as required, to furnish completed and functioning systems.

B. All cables and outlets shall be labeled with a unique identification scheme or as directed by the owner. All labeling shall comply ANSI/TIA/EIA-606.

PART 3: EXECUTION

3.1 Pre-installation site survey

A. Prior to start of systems installation, meet at the project site with representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial scheduled completions.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

3.2 Handling and Protections of Equipment and Materials

A. Be responsible for safekeeping of your own and your subcontractors' property, such as equipment and materials, on the job site. The owner assumes no responsibility for protection of above named property against fire, theft, and environmental conditions.

3.3 Protection of Facilities

A. Effectively protect the owner's facilities, equipment, and materials from dust, dirt, and damage during construction.

B. Remove protection at completion of the work.

3.4 Installation

A. Receive, check, unload, handle, store, and adequately protect equipment and materials to be installed as part of the contract. Store in areas as directed by the owner's representative. Include delivery, unloading, setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment, and other related work whether or not expressly defined herein.

B. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and National Electrical Code (NEC) and with manufacturer's printed instructions.

C. Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.
   1. Where manufacturer does not provide bending radii information, minimum bending radius shall be 10 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the engineer and the owner.

D. Through Wall and Through Floor Penetrations
   1. All through floor and through wall penetrations shall be sleeved using metallic conduit with bushings installed on both sides. The sleeve must be supported or secured on both sides of the wall. Sleeves shall be centered on the wall penetration and have equal amounts extending out off of each wall on both sides. All penetrations shall be installed so both sides are accessible and will easily allow for future cabling. All through floor and through wall penetrations shall be fire-stopped. Fire-stop systems will be performed using UL® approved methods. Provide the UL® system number for the fire-stop systems to be used. Use, It's Unique Firestop Products – Smooth and Threaded Penatrators or approved equivalent.
   2. Provide four-inch sleeves for all through wall and through floor penetrations along all main cable paths in corridors and between floors. A separate sleeve will be installed for data, voice (Category 5e cable), video, ITCS (shielded cabling for speakers, clocks and other devices) and other services. If any sleeve for any or each service will be filled at more than allowed for the fire-stop system to be used install an additional four-inch sleeve. Use It's Unique Firestop Products – Smooth Penatrator P/N #SP-4 for gypsum walls and It's Unique Firestop Products – Threaded Penatrator P/N # TP-4 for block and concrete floors and walls or an approved equivalent.
   3. Provide sleeves as described in 1 and 2 above for entering the Server Room. Provide a minimum of a four inch sleeve for each system (data, voice, video, security, paging, spare). Supply additional sleeves as needed for the number of cables and for the fire-stop system being used.
   4. In addition to all sleeves needed and required provide all necessary sleeves for accessing future surveillance camera locations identified as "SDC".

5. Provide 50% spare capacity for all sleeves for data cabling and 20% spare capacity for all other sleeves.
6. Provide one-two inch sleeve into each classroom and one-one inch sleeve in to each room to be serviced with telecommunications cabling. If the cabling will exceed the number of cables for the fire-stop system being used use a larger sleeve. These sleeves will be used for all telecommunications cabling entering the room to be serviced.
7. Supply and install sleeves in 1 inch, 2 inch and 4 inch sizes only.
8. All sleeves and conduits shall be installed to an accessible ceiling space or access point. Both ends of all sleeves and conduits must be accessible after the project completion.

E. Installation shall conform to the following basic guidelines:
1. Use of approved wire, cable, and wiring devices.
2. Neat and uncluttered wire termination.

F. Cable Paths
1. For the main cable paths attach cable supports to permanent structure with fasteners approved for the material being fastened to at intervals of not more than 48 inches.
2. Support cables installed above removable ceilings using Erico – Caddy Cable Cat, Angled Hanger Bracket P/N # CATHBA with the need number of P/N # CAT32 or P/N # CAT64 cable supports.
   a. Attach the P/N # CAT32 and /or P/N # CAT 64 to the P/N # CATHBA using ¼-20 hardware. Do not use rivets or riveted assemblies.
   b. Attach a P/N # CAT32 or P/N # CAT64 for each of the following systems to be installed along the cable path include one or more for each; data, voice (Category 5e cabling), video, ITCS (shielded cable for speakers, clocks and other devices) and other services (HVAC).
   c. If the P/N # CAT32 will be filled more that 50% of its capacity install P/N # CAT64.
3. Install Erico – Caddy Cable Cat P/N # CAT32 cable support or approved equal and any needed attachments or fasteners with in the classrooms, offices and rooms to support the cabling to be installed.
   a. Cable from all systems will be installed in the same cable path with in the rooms.
   b. If the P/N # CAT32 will be filled more that 50% of its capacity install P/N # CAT64.
4. Install an adequate cable support for service loops at each outlet location. Install a separate cable support for the service loop if the service loop is to be supported along the cable path.
5. Use Erico – Caddy Cable Cat products or approved equivalent. Provide these assemblies in the configurations as detailed.
6. In addition to the supports needed and required provide cable supports for cable paths to the future surveillance camera locations identified as "SDC".

G. Install cables in one continuous piece. No splicing of cables will be acceptable unless otherwise noted.

F. No cabling shall be installed unsupported or laying on ceilings. All cabling shall be concealed.

G. Terminate all cables, at each end, regardless of their "in-service" status, unless noted otherwise.

H. Patch all holes related to the scope of work provided in this specification. The patching is to restore the area in question to pre-existing conditions, and to proper compliance with code(s) and the structural and aesthetic levels required.

I. Connect all equipment cabinets and racks within the Server Room and IDF's with green insulated #6 copper wire. Ground to a ground bar installed in the each Room. Telecommunications Grounding Busbar by division 16. Comply with EIA/TIA 607.

J. Furnish one horizontally mounted six-outlet power strip, with surge suppression and a circuit breaker in the Server Room. Install in floor mounted equipment rack in the Server Room as shown. Each power strip is to be provided with the power cord that is long enough to be neatly routed overhead from the power strip, through the equipment rack(s) and overhead tray to the outlets designated to feed the network electronics.

K. Provide required plates, rings, adapters, blanks and/or accessories to provide a complete installation in all raceways, and other locations. All wall plates shall be flush mounted.

L. Jacks, plates, terminations are to match building standard, in color, finish and quality.

M. Labels and labeling shall conform to EIA/TIA-606.

N. Secure racks to the floor with fully secured recessed anchors. Anchors shall be rated for the material being fastened to. Use a minimum of four (4) anchors per rack.

O. Terminate data and voice station cables in ascending numerical order.

P. Optical fiber in the outlet boxes shall be secured and dressed in so that the optical fiber is secured, has the required slack storage and will not exceed the bend radius requirements of the manufacturer.

Q. Service slack: All horizontal optical fiber cables shall have a minimum of a twenty foot service loop installed at each outlet location and a minimum of a ten foot service loop in the Server Room all other cabling shall have a minimum of a ten-foot service loop supported in the ceiling above each location and neatly coiled in the Server Room. Cables for different systems shall be stored separately.

R. All cabling shall be homerun from the outlet location to the Server Room.

3.5 Grounding

A. Grounding shall conform to ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code and manufacturer's grounding requirements as minimum.

B. Ground equipment racks, housings, messenger cables, raceways, etc as required.

C. An insulated ¼" copper grounding bus bar will be installed in the Server Room as indicated. The ground bar will be provided and installed by division 16.

D. Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via #6 AWG green insulated copper grounding conductor.

3.6 Labeling

A. Labeling shall conform to ANSI/TIA/EIA-606 standards. In addition, provide the following.

B. All labels shall be machine generated. No hand written labels will be permitted for any application.

C. Label each outlet with label sized as recommended by the manufacture for the wall plate being used with minimum 3/16 in. high characters.

D. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:
   1. Inside box at the work area.
   2. At termination point in the Server Room

E. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at the Server Room location that is specific to the facilities terminated therein.

F. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA-606 standard color codes for termination blocks.

G. Label cables, outlets, patch panels, and punch blocks with a letter or number for the Server Room where the cabling will terminate, the section letter or number for the particular area of the building where the outlet is located, the room number in which the outlet is located, followed by a numerical suffix to indicate the outlet location number within the room.

H. Mark up floor plans showing outlet locations, type, and routing of cables. Turn these drawings over to the owner two (2) weeks after completion.

I. One (1) set of as-built drawing shall be delivered to the owner within four (4) weeks of acceptance of project by the owner. A set of as-built drawings shall be provided to the owner in magnetic media form (3.5" floppy disks) utilizing CAD software that is acceptable to the owner. The magnetic media shall be delivered to the owner within two (2) weeks of the acceptance of the project by owner.

3.7 Copper Testing

A. All cables shall be tested and all parameters of each test shall be within acceptable limits for the test being performed. An average of tests or testing a percentage of cables will not be acceptable in any form.

B. The owner or owner's representative shall be invited to and have the opportunity to witness the testing of any and all cables.

C. Testing shall conform to TIA/EIA Transmission Performance Specifications for Field Testing of Unshielded Twisted Cabling Systems, Propagation Delay and Delay Skew Specification for 100 ohm 4-pair cable. Testing shall be accomplished using level III field tester. Provide a current calibration certificate for the test equipment to be used.

D. Test each pair of each cable for all parameters as specified for the Category of cabling being installed. Correct any failed tests

1. Testing of cables shall be in compliance with ANSI/TIA/EIA-568-B and all other applicable standards.
2. Replace any damaged cable.

3.8 Fiber Optic Testing

A. All fiber optic strands shall be tested and shall be equal to or better than the light loss budget for the strand being tested.

B. The owner or owner's representative shall be invited to and have the opportunity to witness the testing of any and all strands.

C. All fiber optic cables shall have a light loss budget figured based on type of cable, cable length, number of connections and number of splices.

D. All Fiber optic cables shall be tested for light loss using a light loss meter that has been calibrated with in one calendar year. Provide a current calibration certificate for the test equipment to be used.
   1. One test cable will be connected to the light meter and one test cable will be connected to the light source these cables will remain connected to the test equipment during all testing to be performed. If the test cables are removed from either unit the reference will need to be figured again.
   2. Use the following referencing method. Attach the un-connected ends of each test cable to an adapter for the connectors being used. Turn on the light meter and light source set both for the same power level. Record the reference number and subtract the reference value from each reading from the strands tested to obtain the light loss for each strand.
   3. Use the same referencing method for test equipment that will calculate the reference and apply it to each test independently.
   4. Test all backbone optical fiber strands in one direction at both 850nm and 1300nm and as required by the manufacturer.
   5. Test all horizontal optical fiber strands in both directions at either 850nm or 1300nm and as required by the manufacturer.

E. Fiber optic test results shall contain for each strand the light loss budget (in decibels), the reference number (in decibels), the light loss (in decibels) and the length of the cable (in feet).

F. Replace any damaged strands that do not meet the testing requirements and / or that do not pass light at all.

3.9 Demonstration / Orientation

A. Provide one half day four (4) hours on site of familiarization and orientation by senior technician of the contractor, or other qualified approved personnel, for each of the voice, data, and video cabling systems. Up to eight (8) owner personnel will be accommodated during this session. This session is to cover as a minimum:
   1. The physical configuration and interrelationship of the components of the system.
   2. Labeling and interconnection techniques used in this installation.
   3. Applications or unique connections or interfaces currently in use on this site.
   4. A review of warranty documents for the system.

B. Coordinate with the owner, and complete training during week prior to occupancy, or as scheduled with the owner.

3.10 Cleaning

A. Prior to presentation for acceptance by client equipment and work areas of this scope shall be cleaned. This work shall include, as necessary, wiping of work areas, removal of streaks, stains, etc., and assurance that systems and components as represented are new and undamaged.

3.11 System Acceptance

A. Contractor must obtain written acceptance from the owner or the owner's representative at the completion of system installation, testing, documentation and training. Failure of the contractor to obtain sign off will result in the contractor remaining responsible for extending, at no charge to the owner, conditions of the warranty and guarantees until such time that sign off had occurred. Time included in the above condition will be presented to the owner in addition to the standard warranties.

3.12 Schedules

A. Cable Schedule Form

B. Provide the building section, room number, type of room and the Server Room number for the location where the cables will terminate.

C. Provide in the column for each type of outlet, the identification number for the type of outlet that is in the room.

END OF SECTION 17100