

ALL TRADES SPECIFICATIONS

CENTER LINE PUBLIC SCHOOLS

PROJECT NUMBER: 121440

MARCH 11, 2013

PROJECT

CENTER LINE PUBLIC SCHOOLS
RISING STARS ACADEMY at
MILLER ELEMENTARY SCHOOL
CENTERLINE, MICHIGAN

OWNER

Center Line Public Schools

26400 Arsenal

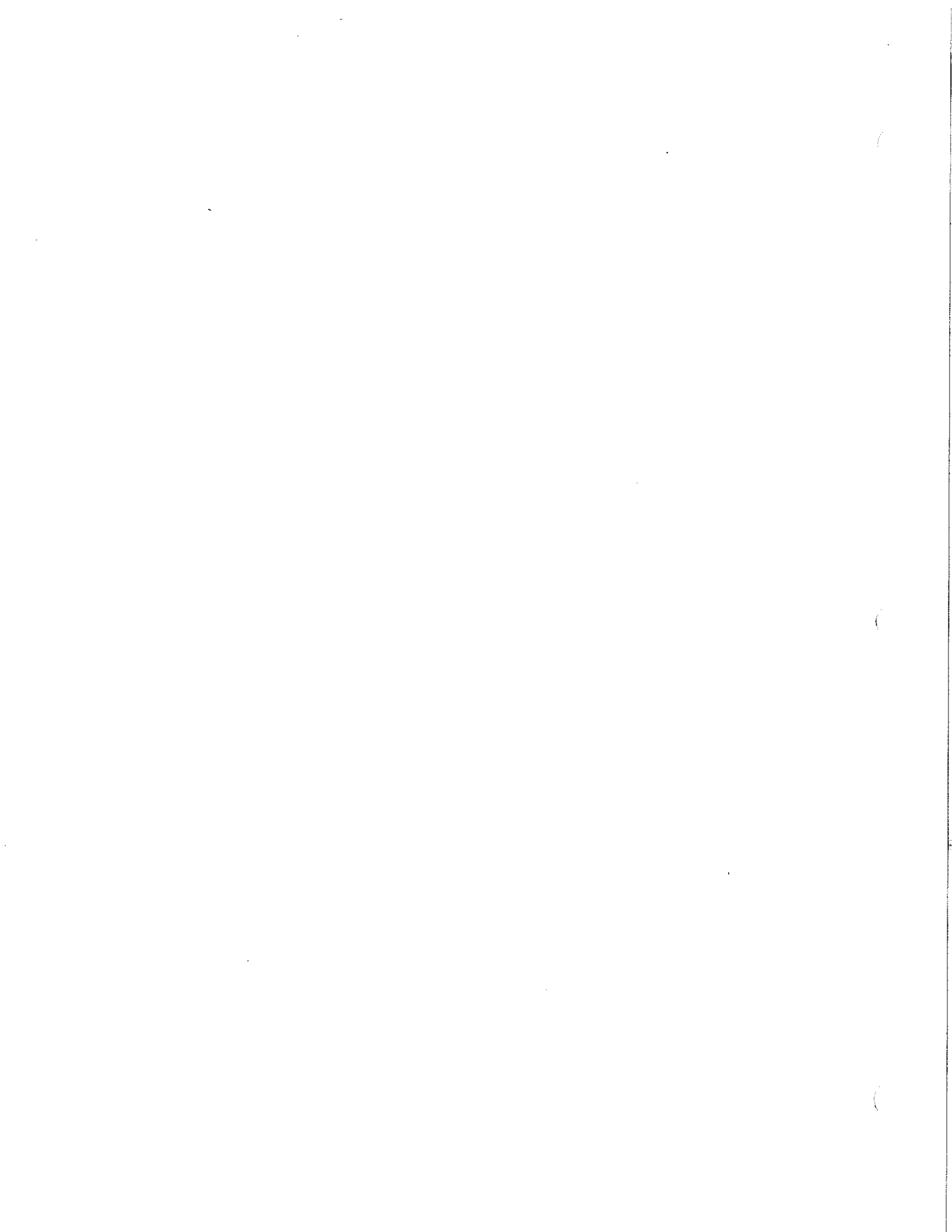
Center Line, Michigan 48015

ARCHITECT

Wakely Associates, Inc.

30500 Van Dyke Ave. - Suite M-7

Warren, Michigan 48093



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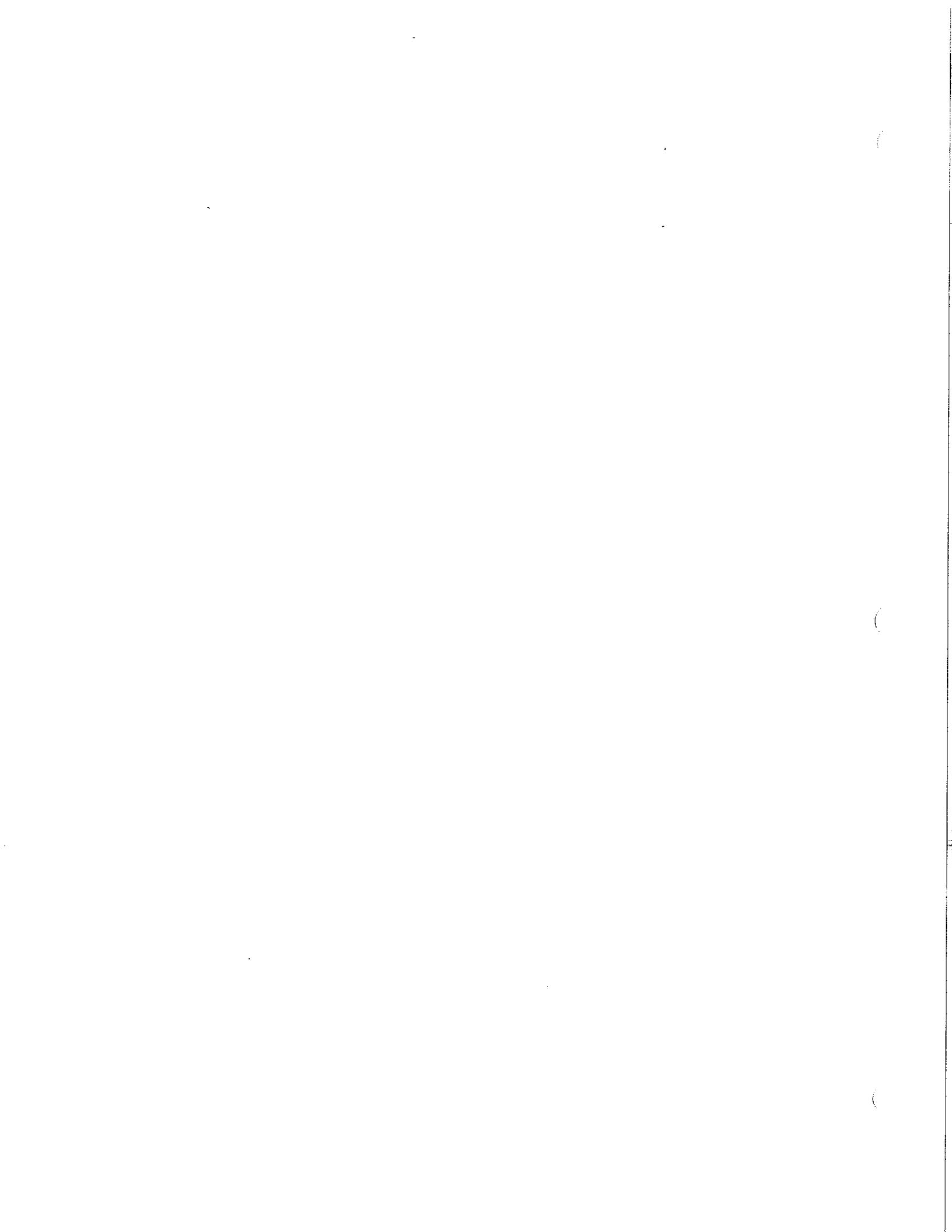
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SECTION 00020 - ADVERTISEMENT FOR BIDS

Center Line Public Schools (CLPS) will receive bids for:

Rising Stars Academy at Miller Elementary School

Until 2:00 p.m., local time, Thursday, April 18, 2013 in the CLPS Administration Building, 26400 Arsenal, Center Line, MI 48015 at which time, and place, all bids will be publicly opened and read aloud in the Board room. Bids received after the above stipulated date and time will not be opened, considered or accepted.

Bid documents can be purchased at the offices of Dunn Blue, 1009 W. Maple Road, Clawson, MI 48107 beginning March 18, 2013.

Bid documents will be available to view from the PlanWell Enterprise System on-line by accessing the website at www.dunnblue.com, clicking on "Enter Planroom" then clicking on "Public Planroom".

All bidders are encouraged to attend a pre-bid meeting on Wednesday, April 10, 2013 at 2:00 p.m. at Miller Elementary School, 23855 Lawrence, Center Line, MI 48015.

Additional walkthroughs of the project building is encouraged and must be scheduled by contacting Craig Anderson at (586) 510-2090.

Prospective bidders must meet the following minimum requirements in order to submit a proposal:

- Must be an established Contractor in Michigan for a minimum of five (5) years
- Have successfully completed a minimum of 3 similar projects in excess of \$ 100,000.00
- Must be technically and financially capable to execute a project of size and complexity
- Must be able to provide business and liability insurance, performance and payment bond for work required by the Bid Documents

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All bids must be submitted on forms furnished in the Contract Documents and be accompanied by a bidder's bond or a certified or cashier's check payable to Center Line Public Schools for the sum of not less than five (5%) of the bid amount. All bids must be accompanied by a sworn and notarized statement disclosing any familial relationship that exists between the Owner (bidder) or any employee of the bidder and any member of the CLPS School Board, Administration or Staff. Bids received without a bidder's bond, certified or cashier's check, and a sworn and notarized statement of disclosure WILL BE GROUNDS FOR REJECTION.

Center Line Public Schools reserves the right to reject any or all bids, in whole or in part, to waive any irregularities therein and accept that bid, which best serves Center Line Public Schools interest.

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SECTION 00100 - INSTRUCTIONS TO BIDDERS

Owner will receive sealed proposals only as set forth in the Invitation to Bid and complying with all requirements as contained in Instructions to Bidders.

DOCUMENTS

Bid Documents will be available to view from the PlanWell Enterprise System on-line by accessing the website at www.dunnblue.com clicking on "Enter Planroom" then clicking on "Public Planroom".

Bid Documents will be available for purchase at Dunn Blue - Clawson, 1009 W. Maple Road, Clawson, MI 48017, 248-288-5600.

Bid Documents will be available to view or order beginning March 18, 2013.

BIDDING DOCUMENTS

The Bidding Documents consist of the following:

- The Drawings as enumerated in Section 00851, Index of Drawings.

- The Specifications as enumerated in the Table of Contents.

- All other documents as provided for in Article 1, Paragraph 1, Section 1 of the General Conditions as modified.

EXAMINATION

Each bidder shall examine the Bidding Documents and satisfy himself about the extent of the proposed work by personal examinations of the site and surroundings, and make his own estimate therefrom of the facilities and difficulties attending the performance and completion of the job.

No additional compensation will be allowed on account of conditions which could be determined by examining the Bidding Documents or the site.

INTERPRETATION

If any person contemplating submitting a bid is in doubt as to the true meaning of any part of the Drawings, Specifications, or other Bidding Documents, he must notify the Architect/Engineer through Wakely Associates Inc.-Attn: Brian J. Smilnak, AIA. Fax: 586-573-0822 Email: bsmilnak@wakelyaia.com with written request for an interpretation thereof. If such an interpretation is not requested, the bids will be presumed to be based upon the interpretation and directions given by Wakely Associates Inc. after Contract award, in accordance with provisions of the Contract.

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Neither the Owner nor the Architect/Engineer will be responsible for any verbal explanations or interpretations of the Bidding Documents.

Every request for such interpretation should be in writing, addressed to Wakely Associates Inc. Attn: Brian J. Smilnak, AIA at this office, and to be given consideration, must be received at least five (5) business days prior to the date fixed for the opening of bids. Any and all such interpretations, and any supplemental instructions will be in the form of written addenda to the Bidding Documents which, if issued, will be mailed to all prospective bidders (at the respective address furnished for such purposes) prior to the date fixed for the opening of bids. All addenda so issued shall become part of the Bidding Documents.

SUBSTITUTIONS

To obtain approval to use unspecified products, bidders shall submit written requests at least ten (10) days before the bid date and hours. Requests received after this time will not be considered. Requests shall clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. If the product is acceptable to the Architect/Engineer, the Architect will approve it in an Addendum issued to all prime bidders on record.

BASIS OF BID

A single lump sum proposal is being entertained per bid category for the work of this proposal.

Partial or segregated bids or assignments will not be considered. Include quotes for all alternates and unit prices; failure to do so may result in rejection of proposal.

PREPARATION

Proposal shall be submitted on the form bound in these specifications, Form of Proposal, in original form without erasures, interlineations or alterations.

Submit three (3) copies of proposal, retain one for your records. Oral, telegraphic, electronic or telephone proposals will not be accepted.

Proposals must be filled out in ink or typewritten in duplicate. Blank spaces in the proposals must be filled in and no changes shall be made to the phraseology of the proposal. Quotes shall be entered in verbal and numeric forms. In case of a discrepancy between the written and the numeric form, the written form shall govern.

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All bids shall be signed and dated in longhand.
Bids which are not signed by the individual making them should have attached thereto a power of attorney, evidencing authority to act as agent for the person whom it is signed.

Bids which are signed for a partnership should be signed by one of the partners or by an attorney-in-fact. If signed by an attorney-in-fact, evidence of authority to sign the bids shall be attached.

Bids which are signed for a corporation should have the correct corporate name thereon and the signature of the president or other officer legally able to contract in the name of the corporations. In addition, a signed Secretary's Certificate evidencing the authority of the Officer to contract in the name of the corporation shall be included. Any proposal submitted by a corporation shall bear its seal.

BID SECURITY

The successful bidders securities will be retained until they have signed the Contract and furnished the required payment and performance bonds. The Owner reserves the right to retain the security of the next two lowest bidders for each contract until the lowest bidders enter into contract, or until sixty (60) days after the bid opening, whichever is the shorter. All other bid security will be returned as soon as practicable. If any bidder refuses to enter into a Contract, the Owner will retain his Bid Security as liquidated damages, but not as a penalty.

SUBCONTRACTORS

The Owner and Architect reserve the right to require of bidders tentatively selected for consideration in the awarding of the Contract, a list of the subcontractors whom the Contractor intends to employ.

The Owner reserves the right to disapprove the use of any proposed subcontractor, and in such event, the bidder submitting such subcontractor shall submit another such subcontractor in like manner within the time specified by the Owner. The Owner reserves the right to reject any bid if such information required by the Owner is not submitted as above indicated.

SUBMITTAL

Submit proposals with the Familial Disclosure Form and Bid Security in sealed opaque envelopes having listed thereon the following:

**PROPOSAL: CENTER LINE PUBLIC SCHOOLS
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BID CATEGORY: _____**

Contractor: _____

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Deliver proposals until 2:00 p.m., Thursday, April 18, 2013 to the Center Line Public Schools Administration Building, 26400 Arsenal, Center Line, MI 48015, at which time proposals will be publicly opened and read aloud in the Board Room.

WITHDRAWAL

Proposals for base bids may not be withdrawn for a period of sixty (60) days after the time established for the receiving of proposals. Bidders may withdraw at any time prior to the time set for the receiving of proposals.

IRREGULARITIES

The Owner reserves the right to disqualify Bids before or after opening, upon evidence of collusion with intent to defraud, or other illegal practices upon the part of the bidder.

The Owner also reserves the right to reject any or all bids in whole or in part and to waive any informalities therein.

Any error and/or omission in the proposal form or any other irregularity as a result of negligent preparation shall not furnish cause for relief for any damages resulting therefrom, nor in any way relieve the Contractor from fulfillment of all contractual obligations as provided for in the Bidding Documents.

TAXES AND CONTRIBUTIONS

Proposal, unit prices, alternate prices stated include all taxes or contributions required by bidders business.

Michigan State sales tax is applicable to this work.

OPENING

Proposals will be publicly opened and read aloud.

BID BREAKDOWN CONSTRUCTION INFORMATION

Upon notice from Wakely Associates Inc., the low bidders shall submit a detailed cost breakdown of all work covered by the Bidding Documents. The breakdown shall show quantity of material and labor, units of material and labor, material cost, labor cost and total cost.

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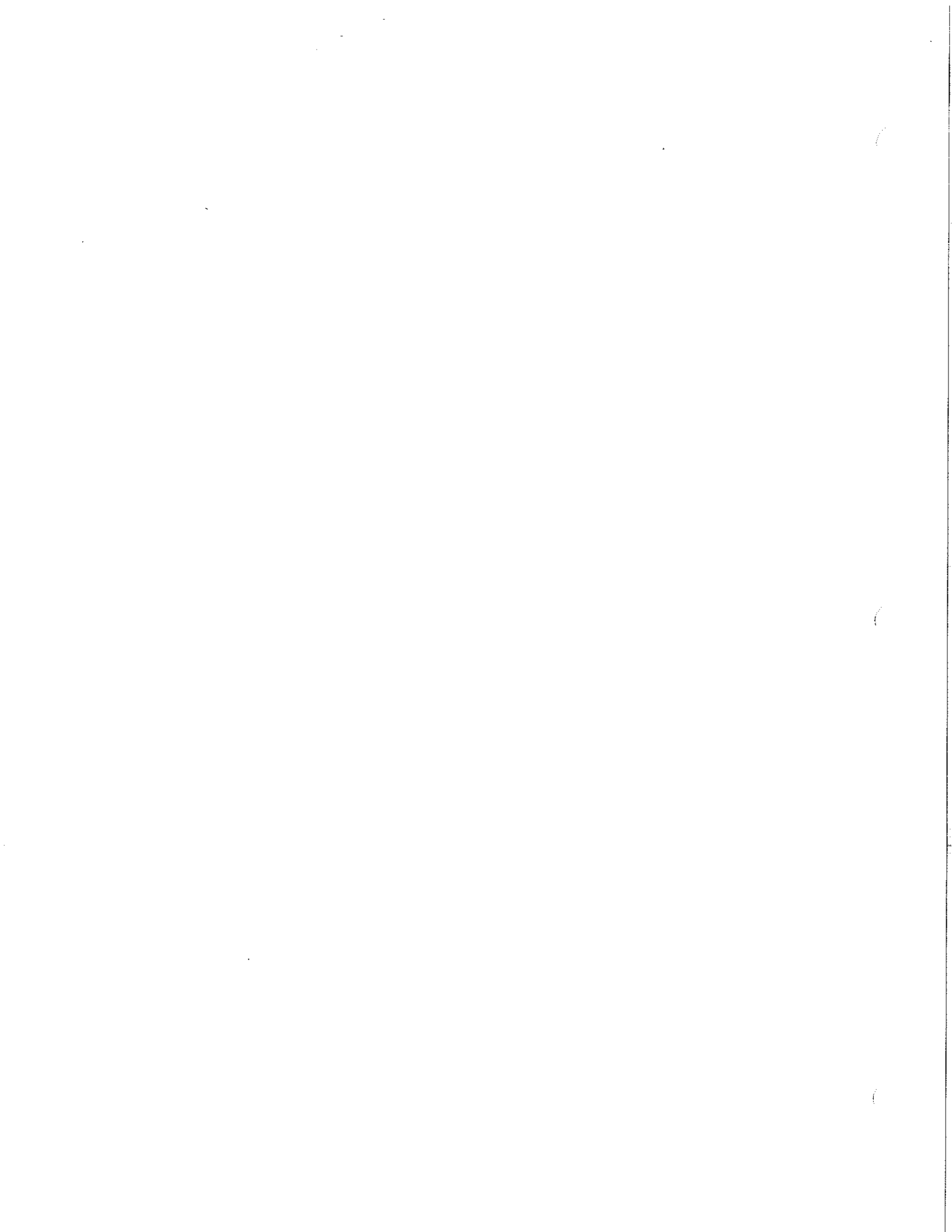
AWARD OF CONTRACT

The Contract will be awarded to the lowest responsible bids, complying with the terms of the Bidding Documents, with full consideration of alternates.

EXECUTION OF CONTRACT

The Owner reserves the right to accept any and all bids, or to negotiate contract terms with the various bidders when such is deemed by the Owner to be in his best interest.

END OF SECTION 00100



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Center Line Public Schools

Rising Stars Academy at Miller Elementary School

Bids Due: Thursday, April 18, 2013 at 2:00 p.m. local time

Bid To: Mrs. Cynthia Schwark, Director, Business Services

Name of Bidder: _____

- A. The undersigned BIDDER proposed and agrees, if this Bid is accepted, to enter into an Agreement with the OWNER to complete all Work as specified or indicated in the Bidding Documents.
- B. BIDDER accepts all of the terms and conditions of the Bidding Documents including without limitation those dealing with the disposition of bid Security. This Bid will remain open for 60 days after the day of Bid opening.
- C. In submitting this Bid, BIDDER represents, as more fully set forth in the Bidding Documents that:
 - 1. BIDDER has examined a complete set of the Bidding Documents including any Addenda herein, receipt of which shall be acknowledged.

Date

Addenda Number

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2. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (Federal, state and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work, and has made such independent investigations as BIDDER deems necessary.
3. The Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any other agreement or rules of any group, association, organization or corporation; BIDDER has not directly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or a corporation to refrain from advantage over any other Bidder or over the OWNER.
4. The Bidder agrees that the prices set forth are correct and that no mistakes or error has occurred in the Bidder's computations.
5. The Bidder understands that the Owner will not be liable for any amount in excess of the Bid Amount, except as expressly stated in written Change Orders duly executed and delivered by the Owner.
6. The Bidder declares that in preparing this Bid, all labor, materials and products are available to meet the completion date.
7. The Bidder agrees that the Owner reserves the right to accept or reject this Bid, or any portion thereof.

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For the Scope of Services as described and required in the Bid Documents Dated 3/11/13.

Architectural Trades - Category 02000:

- a. Base Bid is a Lump Sum Cost of _____ \$ _____
- b. 100% PLM Bond is a Lump Sum Cost of _____ \$ _____
- c. **Total Base Bid + Lump Sum PLM Bond Cost** _____ \$ _____

Mechanical Trades - Category 15000:

- a. Base Bid is a Lump Sum Cost of _____ \$ _____
- b. 100% PLM Bond is a Lump Sum Cost of _____ \$ _____
- c. **Total Base Bid + Lump Sum PLM Bond Cost** _____ \$ _____

Electrical Trades - Category 16000:

- a. Base Bid is a Lump Sum Cost of _____ \$ _____
- b. 100% PLM Bond is a Lump Sum Cost of _____ \$ _____
- c. **Total Base Bid + Lump Sum PLM Bond Cost** _____ \$ _____

Combination Proposal (All 3 Categories - A/M/E)

- a. Base Bid is a Lump Sum Cost of _____ \$ _____
- b. 100% PLM Bond is a Lump Sum Cost of _____ \$ _____
- c. **Total Base Bid + Lump Sum PLM Bond Cost** _____ \$ _____

2. Schedule

The Bidder agrees that the work will be substantially and fully completed on or before July 26, 2013.

Suppliers Sub-Contractors

Please list all suppliers and subcontractors below:

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I have read and I understand the responsibilities required of Contractor under the Agreement between the Owner and Contractor, which is provided with the Documents. If selected, our company will be able to fulfill the requirements. This proposal must be signed by an officer of the firm who is authorized to enter into binding agreements.

SIGNATURE

Dated this _____ day of _____, 2013.

Name of Organization:

By: _____
Signature

Title: _____

_____, being duly sworn,
deposes and says that the information provided herein is true
and sufficiently complete so as not to be misleading.

Subscribed and sworn before me this _____ day of
_____, 2013.

Notary Public:

My Commission Expires:

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FAMILIAL DISCLOSURE STATEMENT

All bidders must submit the following familial disclosure statement in compliance with Section 1267 of the Revised School Code (MCL 380.1287) and attach this form to the bid. **The Center Line Public Schools shall not accept a bid that does not include this sworn and notarized statement.** The Familial Disclosure Statement must be completed in its entirety.

By this sworn and notarized statement, I am disclosing the familial relationship(s) that exists between the owner(s) or any employee of the firm and any member of the Center Line Public Schools Board or the Superintendent of Center Line Public Schools as follows: (Please provide owner/employee name, position, name of relative and the nature of the familial relationship or state NONE).

Owner/Employee Name	Position	Name of Relative (Board Member/Superintendent)	Nature of Relationship
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Note: Any additional disclosures must also be sworn and notarized.

Signature: _____ Title: _____

Name of Firm: _____

STATE OF MICHIGAN)
) SS
COUNTY)

On this _____ day of _____, 2013, before me, a Notary Public, in and for said county, personally appeared _____, agent of the firm _____, and who acknowledges the same to his free act and deed as such agent.

Notary Public

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SECTION 00710 - GENERAL CONDITIONS

DOCUMENTS:

"The General Conditions of the Contract for the Construction"
A.I.A. Documents A-201, April 2007 Edition, Forms a part of these
Specifications and shall have the same effect as if bound herein.

This Document is modified as described in Modifications of the
General Conditions.

Contractors shall be held responsible for having familiarized
themselves with this Document and all other documents affecting
their contracts in this Specification.

END OF SECTION 00710

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SECTION 00810 - MODIFICATIONS OF THE GENERAL CONDITIONS

The following modify, change, delete from, or add to the "General Conditions of the Contract for Construction" AIA Document A201, 2007 Edition. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of that Article, Paragraph, Subparagraph, or Clause shall remain in effect.

ARTICLE 1, GENERAL PROVISIONS

Add the following Subparagraph to Paragraph 1:

1.2.4 Work not covered in the Contract Documents will not be required, unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce the intended results. Where reference is made to specifications of manufacturers, trade associations or the like, such is understood to be made a part of this Specification to have the same effect as if fully reproduced herein. Approval or equal, acceptable, and words of similar definition are understood to mean in the judgment of Architect.

Add the following Subparagraph to Paragraph 1:

1.2.5 Computed dimensions take precedence over scaled dimensions, large scale details over smaller; should disagreements occur in the drawings, or the Specifications describe a higher quality of work or material, the better quality shall be estimated, unless otherwise directed by the Architect. The Architect shall be notified at once, in writing, of any and all discrepancies.

ARTICLE 3, CONTRACTOR

Add the following Subparagraph to paragraph 3:

3.4.4 After the Contract has been executed, the Owner and the Architect will consider a formal written request for the substitution of products in place of those specified only under the conditions set forth herein.

3.4.5 By making requests for substitutions based on Clause 3.1.3. above, the Contractor:

- (a) represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

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- (b) represents that he will provide the same warranty for the substitution that he would for that specified;
- (c) certifies that the cost data presented is complete and includes all related costs under this Contract, but excludes cost under separate contract, and excludes the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and
- (d) will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.

Change Paragraph 3.7, Subparagraph 1, to read as follows:

3.7.1 General Trades Contractor shall secure and Owner pay for general building permit. General, Mechanical and Electrical Trades Contractors shall secure and pay for all other permits and governmental fees, licenses and inspections as their work may require for the proper execution and completion of the Work which are customarily secured after execution of the Contract and which are legally required at the time the bids are received.

3.7.1.1. Owner will pay for all sewer and water escrow fees, capital charges, assessment fees, and frontage fees.

3.7.1.2. All other fees, permits and tapping charges shall be applied for and obtained by Mechanical Trades Contractor, and shall be paid for by the Owner.

ARTICLE 5, SUBCONTRACTOR

Add the following Subparagraph to Paragraph 5:

5.2.1.1. No later than 10 days after the award of contract the Contractor shall furnish, in writing to the Owner through the Architect the names of persons or entities proposed or manufacturers for each of the products identified in the General Requirements (Division of the Specifications) and where applicable, the name of the installing subcontractor.

Article 7, CHANGES IN THE WORK

Add the following sentence to paragraph 7.3.7

7.3.7.6 The Contractor shall not incur any cost to be reimbursed as part of the adjustment in the contract sum prior to the commencement of the construction phase.

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ARTICLE 8, TIME

8.3.1 Delete reference to arbitration.

ARTICLE 9, PAYMENTS AND COMPLETION

Add the following sentence to Subparagraph 9.3.1.:

The form of Application for Payment shall be a notarized AIA Document G702, Application and Certification for payment, supported by AIA Document G703, Continuation Sheet.

Add the following Clause 9.3.1.3. to 9.3.1:

Until the work is 50% complete, the Owner shall pay 90% of the amount due the Contractor on account of progress payments. At the time the work is 50% complete and thereafter, the Architect may, upon written request and satisfactory progress authorize remaining partial payments to be paid in full.

ARTICLE 11, INSURANCE AND BONDS

Add the following Subparagraph:

11.1.1.9. Liability Insurance shall include all major divisions of coverage on a comprehensive basis including:

- (1) Premised-Operations (including X-C-U)
- (2) Independent Contractors Protective
- (3) Products and Completed Operations
- (4) Personal Injury Liability with Employment Exclusion deleted.
- (5) Contractual-including specified provisions for Contractor's Obligation under Paragraph 3-18
- (6) Owned, non-owned, and hired motor vehicles.
- (7) Broad Form Property Damage, including Complete Operations.

Add the following Subparagraph:

11.1.1.1. If the General Liability coverages are provided by a Commercial General Liability Policy on a claims-made basis, the policy date or Retroactive Date shall predate the Contract; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with subparagraph 9.10.2.

Add the following Subparagraph:

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11.1.2.1. The Insurance required by Subparagraph 11.1.1. shall be written for not less than any limits of liability specified in the Contract Documents, or required by law, whichever is greater. Provide minimum limits as follows:

- (1) Worker's Compensation:
 - (a) State - statutory
 - (b) Applicable Federal - statutory
 - (c) Employer's Liability - \$100,000
 - (d) Benefits required by Labor Union Contracts.
- (2) Comprehensive General Liability, including Premises-Operations, Independent Contractor's Protective, Products and Completed Operations, and Broad Form Property Damage:
 - (a) Bodily Injury:

\$1,000,000 Each Occurrence
\$1,000,000 Aggregate Products and Completed Operations
 - (b) Property Damage:

\$1,000,000 Each Occurrence
\$1,000,000 Aggregate
 - (c) Product and Completed Operations Insurance shall be maintained for a minimum period of one year after final payment, and Contractor shall continue to provide evidence of such coverage to Owner on an annual basis during the coverage period. Name **Center Line Public Schools** as additionally insured primary coverage.
 - (d) Property Damage Liability Insurance shall include coverage for X (Explosion), C (Collapse) and U (Underground).
 - (e) Contractual Liability (Hold Harmless Coverage):

Bodily Injury - \$1,000,000 Each Occurrence
Property Damage - \$1,000,000 Each Occurrence
\$1,000,000 Aggregate

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- (f) Personal Injury with Employment Exclusion
deleted:
\$1,000,000 Aggregate
- (3) Comprehensive Automotive Liability (Owner, non-
owned, hired):
 - (a) Bodily Injury:
\$500,000 Each Person
\$1,000,000 Each Accident
 - (b) Property Damage:
\$1,000,000 Each Occurrence

Add the following sentence to Subparagraph 11.1.3.:

If this Insurance is written on the Comprehensive General Liability Policy form, the Certificates shall be AIA Document G705, Certificates of Insurance. If this Insurance is written on a Commercial General Liability Policy form, ACORD form 255 will be acceptable.

Add the following sentence to Clause 11.3.1.1.:

The form of policy for this coverage shall be Complete Value.

Delete Clause 11.3.1.4 and substitute the following:

11.3.1.4 The Contractor shall provide insurance coverage for portions of the Work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the Work in transit.

11.3.9 Revise third sentence to read:

The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or in accordance with a mediation or litigation award in which case the procedure shall be as directed by the mediator or the Court.

11.3.10 Revise second sentence to read:

The Owner as fiduciary shall in the case of mediation or litigation make settlement with insurers in accordance with the directions of the mediator or the Court. If distribution of insurance proceeds by mediation or litigation is required the mediator or the Court will direct such distribution.

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11.4, PERFORMANCE BOND AND PAYMENT BOND

Delete Subparagraph 11.4.1 and substitute the following paragraphs:

11.4.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising hereunder. Bonds may be obtained through the Contractor's usual source and the cost thereof shall be included in the Contract Sum. The amount of each bond shall be equal to 100% percent of the Contract Sum.

11.4.1.1 The Contractor shall deliver the required bonds to the Owner not later than five days following the date the Agreement is entered into, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

11.4.1.2 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

Add the following Paragraph 13.8 to Article 13:

13.8 EQUAL OPPORTUNITY

13.8.1 The Contractor shall maintain policies of employment as follows:

13.8.1.1 The Contractor and the Contractor's 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.

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13.8.1.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or 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.

ARTICLE 15, CLAIMS AND DISPUTES

15.3 Mediation

15.3.2 Delete reference to Arbitration and substitute litigation.

15.3.2 Revise paragraph to read:

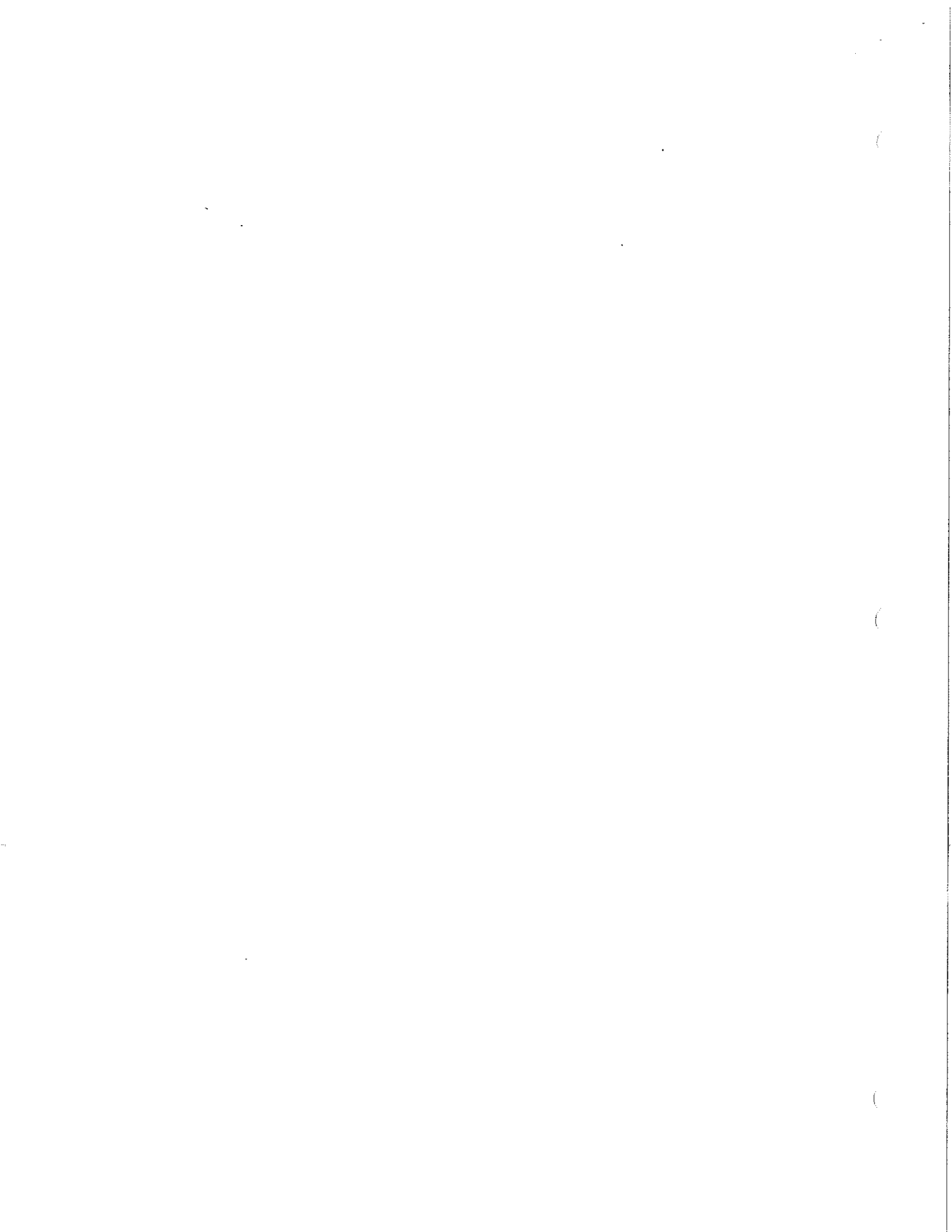
The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association in effect on the date of this agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the American Arbitration Association. The request may be made concurrently with the filing for litigation but, in such event, mediation shall proceed in advance of litigation or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or Court order.

15.4 Delete reference to arbitration. Binding dispute resolution shall be by litigation in a court of law having jurisdiction.

15.4.4 CONSOLIDATION OR JOINDER

15.4.4.1, 15.4.4.2, 15.4.4.3
Delete reference to arbitration and substitute mediation

END OF SECTION 00810



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SECTION 00851 - INDEX OF DRAWINGS

The following drawings, dated March 11, 2013, are issued for Center Line Public Schools, Rising Stars Academy at Miller Elementary School, 23855 Lawrence, Center Line, MI 48015. Architect's Project Number 121440.

TITLE SHEET

ARCHITECTURAL:

- A1.0 COMPOSITE FLOOR PLAN AND TOILET ROOM DEMOLITION AND NEW WORK ENLARGED PLANS
- A2.0 KITCHEN DEMOLITION PLAN, NEW WORK PLAN AND DETAILS

FOOD SERVICE EQUIPMENT:

- FSE-1 FOOD SERVICE EQUIPMENT LAYOUT
- FSE-2 FOOD SERVICE EQUIPMENT ELECTRICAL ROUGH-IN PLAN
- FSE-3 FOOD SERVICE EQUIPMENT PLUMBING ROUGH-IN PLAN
- FSE-4 FOOD SERVICE EQUIPMENT VENTILATION ROUGH-IN PLAN
- FSE-5 FOOD SERVICE EQUIPMENT ELEVATION DETAILS

MECHANICAL:

- M0.1 MECHANICAL STANDARDS AND DRAWING INDEX
- M5.1 ENLARGED KITCHEN MECHANICAL PLANS
- M5.2 ENLARGED TOILET ROOM MECHANICAL PLANS
- M6.1 MECHANICAL DETAILS
- M7.1 MECHANICAL SCHEDULES
- M7.2 MECHANICAL SCHEDULES
- M8.1 TEMPERATURE CONTROL STANDARDS AND GENERAL NOTES
- M8.2 TEMPERATURE CONTROLS

ELECTRICAL:

- E0.1 ELECTRICAL STANDARDS AND DRAWING INDEX
- E0.2 ELECTRICAL STANDARD SCHEDULES AND RISER DIAGRAM
- E0.4 ELECTRICAL COMPOSITE PLAN
- ED1.1 ELECTRICAL DEMOLITION PLAN
- E2.1 LIGHTING PLAN
- E3.1 POWER PLAN
- E6.1 ENLARGED KITCHEN POWER PLAN
- E7.1 ELECTRICAL DETAILS

END OF SECTION 00851

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SECTION 01010 - SUMMARY OF WORK AND SCHEDULE

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this section.

1.02 PROJECT:

- A. The work consists of:
 - 1. Removal of existing kitchen equipment and existing wall and floor construction as indicated on the documents and specifications.
 - 2. Installation of new kitchen equipment, walls, ceiling, HVAC, finishes, etc. as indicated on the documents and specifications.

1.03 CONTRACT:

- A. A single lump sum proposal will be received for the work of this proposal.

1.04 SCHEDULE:

- A. The area will be made available for the Contractor on May 1, 2013 to begin work.

PARTS 2 & 3 - PRODUCT AND EXECUTION

Not applicable

END OF SECTION 01010

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SECTION 01050 - COORDINATION

PART 1 - GENERAL

1.01 PRE-JOB MEETING AND COMMENCEMENT OF WORK

- A. A Pre-Job Meeting will be held after the project has been awarded, prior to the start of work. This meeting shall include the Architect, successful Bidder as Contractor and the Owner's Representative. The condition of the buildings and related ground areas shall be recorded, and this Contractor shall be held responsible for the correction and/or repair of any damage to the buildings and grounds resulting from the work of the Contract that is different from the conditions noted at the Pre-Job Meeting.
- B. The Contractor shall begin the work of this project at a date established at this meeting.

1.02 PROGRESS MEETINGS

- A. At regular monthly or other suitable intervals at the request of the Owner's Representative a meeting will be held at the project site to determine the progress of the work as it relates to the schedule initially agreed upon between the Owner and the Contractor.
- B. The Contractor and Subcontractors for the major trades shall be represented at these meetings by persons having full authority to act for them in regard to all portions of the work.

1.03 JOB COORDINATION AND EXPEDITING

- A. It shall be the full responsibility of the Contractor to coordinate and expedite all phases of the work, regardless of whether the Owner awards separate contracts for any trades, branches or items of work and equipment. All separate Contractors and Subcontractors for all trades shall cooperate fully with this Contractor.
- B. The organization of the Specifications into Divisions, Sections and Parts and the arrangement of the 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.

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C. The Contractor's work day shall avoid conflict with Owner's activities.

1.04 ESTABLISHING LINES AND GRADES

The Contractor shall accurately establish all principal lines, grades, levels and reference points required. Each Subcontractor or separate Contractor shall lay out his own work to dimension from principal lines and be responsible for the layout of his Sub-Subcontractors' work. Upon completion of the work, the Contractor shall furnish evidence that all work has been properly located in conformance with the Contract Documents.

1.05 BUILDING CODES AND LAWS

The Contractor has the responsibility of complying with all applicable building codes and laws pertaining to this project.

1.06 WORKMANSHIP

All workmen shall be thoroughly experienced in the particular class of work in which they are employed. The Owner reserves the right to demand removal from this project any member of the Contractor's staff that, in the Owner's opinion, impedes the progress of the project.

1.07 ASBESTOS IN CONSTRUCTION MATERIALS

Materials and products containing asbestos particles may not be employed in the work of this Contract.

END OF SECTION 01050

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SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Quality assurance.
- B. Schedule of references.

1.02 QUALITY ASSURANCE:

- A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date for receiving bids.
- C. Obtain copies of standards when required by Contract Documents.
- D. Maintain copy at job site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- F. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.04 SCHEDULE OF REFERENCE:

- AA Aluminum Association
900 19th Street, N.W. - Suite 300
Washington, DC 20006
- AABC Associated Air Balance Council
1518 K Street N.W.
Washington, DC 20005
- AASHTO American Association of State Highway
and Transportation Officials
444 North Capitol Street, N.W. - Suite 249
Washington, DC 20001

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ACI American Concrete Institute
P.O. Box 9094
Farmington Hills, MI 48333-9094

ADC Air Diffusion Council
1901 N. Roselle Rd., Suite 800
Schaumburg, IL 60195

AF&PA American Forest & Paper Association
1111 19th Street, NW, Suite 800
Washington, DC 20036

AGC Associated General Contractors of America
2300 Wilson Blvd., Suite 400
Arlington, VA 22201

AI Asphalt Institute
2696 Research Park Drive
Lexington, KY 40511-8480

AIA American Institute of Architects
1735 New York Avenue, N.W.
Washington, DC 20006-5292

AISC American Institute of Steel Construction
One East Wacker Drive
Suite 3100
Chicago, IL 60601-2001

AISI American Iron and Steel Institute
1140 Connecticut Ave - Suite 705
Washington, DC 20036

AITC American Institute of Timber Construction
7012 S. Revere Parkway - Suite 140
Englewood, CO 80112

AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004

ANSI American National Standards Institute
25 West 43rd Street, Fourth Floor
New York, NY 10036

APA American Plywood Association
Box 11700
Tacoma, WA 98411-0700

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ARI Air Conditioning and Refrigeration Institute
4100 North Fairfax Drive - Suite 200
Arlington, VA 22203

ASHRAE American Society of Heating, Refrigeration and
Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, GA 30329

ASME American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

ASTM American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

AWI Architectural Woodwork Institute
46179 Westlake Drive, Suite 120
Potomac Falls, VA 20165

AWPA American Wood-Preservers' Association
P.O. Box 5690
Grandbury, TX 76049

AWS American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

BIA Brick Institute of America
1350 Centennial Park Drive, Suite 301
Reston, VA 20191

CDA Copper Development Association
260 Madison Avenue - 16th Floor
New York, NY 10016

CLFMI Chain Link Fence Manufacturers Institute
10015 Old Columbia Road, Suite B-215
Columbia, MD 21046

CRSI Concrete Reinforcing Steel Institute
933 Plum Grove Road
Schaumburg, IL 60173-4758

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CSSB Cedar Shake and Shingle Bureau
P.O. Box 1178
Sumas, WA 98295-1178

DHI Door and Hardware Institute
14150 Newbrook Drive, Suite 200
Chantilly, VA 20151

EJCDC Engineers' Joint Contract Documents Committee
American Council of Engineering Companies
1015 15th Street, N.W., 8th Floor
Washington, DC 20005

EJMA Expansion Joint Manufacturers Association
25 North Broadway
Tarrytown, NY 10591

FGMA Flat Glass Marketing Association
3310 Harrison
White Lakes Professional Building
Topeka, KS 66611

FM Factory Mutual System
Standards Laboratories Department
1151 Boston-Providence Turnpike
Norwood, MA 02062

FS Federal Specification
General Services Administration
Specifications and Consumer Information
Distribution Section (WFSIS)
1800 F Street, NW
Washington, DC 20405

GA Gypsum Association
810 First Street N.W. #510
Washington, DC 20002-4268

ICC International Code Council
5203 Leesburg Pike, Suite 600
Falls Church, VA 22041

IEEE Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017

IMIAC International Masonry Industry All-Weather Council
International Masonry Institute
815 15th Street, N.W.
Washington, DC 20005

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MBMA Metal Building Manufacturer's Association
1300 Sumner Avenue
Cleveland, OH 44115-2351

MFMA Maple Flooring Manufacturers Association
60 Revere Drive
Northbrook, IL 60062

MIL Military Specification
Naval Publications and Forms Center
700 Robbins Avenue, Building 4, Section D
Philadelphia, PA 19111-5093

ML/SFA Metal Lath/Steel Framing Association
Division of National Association of Architectural Metal
Manufacturers (NAAMM MLIFSA)
600 South Federal Street, Suite 400
Chicago, IL 60605

NAAMM National Association of Architectural Metal
Manufacturers
800 Roosevelt Road, Building C, Suite 312
Glen Ellyn, IL 60137

NCMA National Concrete Masonry Association
2302 Horse Pen Road
Herndon, VA 22071-3499

NEBB National Environmental Balancing Bureau
8575 Grovement Circle
Gaithersburg, MD 20877

NEMA National Electrical Manufacturers' Association
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209

NFPA National Fire Protection Association
#1 Battery March Park
Quincy, MA 02269-9101

NSWMA National Solid Wastes Management Association
4301 Connecticut Avenue, N.W., Suite 300
Washington, DC 20008-2304

NTMA National Terrazzo and Mosaic Association
201 North Maple, Suite 208
Purcellville, VA 20132

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PCA Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

PCI Precast Prestressed Concrete Institute
175 W. Jackson Blvd.-Suite 1859
Chicago, IL 60604-9773

PS Product Standard
U.S. Department of Commerce
1401 Constitution Avenue, N.W.
Washington, DC 20230

RIS Redwood Inspection Service
Division of California Redwood Association
405 Enfrente Drive
Novato, CA 94949

SDI Steel Deck Institute
P.O. Box 25
Fox River Grove, IL 60021

SDI Steel Door Institute
c/o Wherry Associates
30200 Detroit Road
Cleveland, OH 44145-1967

SIGMA Sealed Insulating Glass Manufacturers Association
401 N. Michigan Avenue
Chicago, IL 60611

SJI Steel Joist Institute
3127 10th Avenue North
Myrtle Beach, SC 29577-6760

SMACNA Sheet Metal and Air Conditioning Contractors'
National Association
4201 Lafayette Center Drive
Chantilly, VA 20151-1209

SSPC Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656

TCNA Tile Council of North America, Inc.
100 Clemson Research Blvd.
Anderson, SC 29625

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TPI Turfgrass Producers International
2 East Main Street
East Dundee, IL 60118

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062-2096

WCLIB West Coast Lumber Inspection Bureau
6980 S.W. Varns Road
Tigard, OR 97223

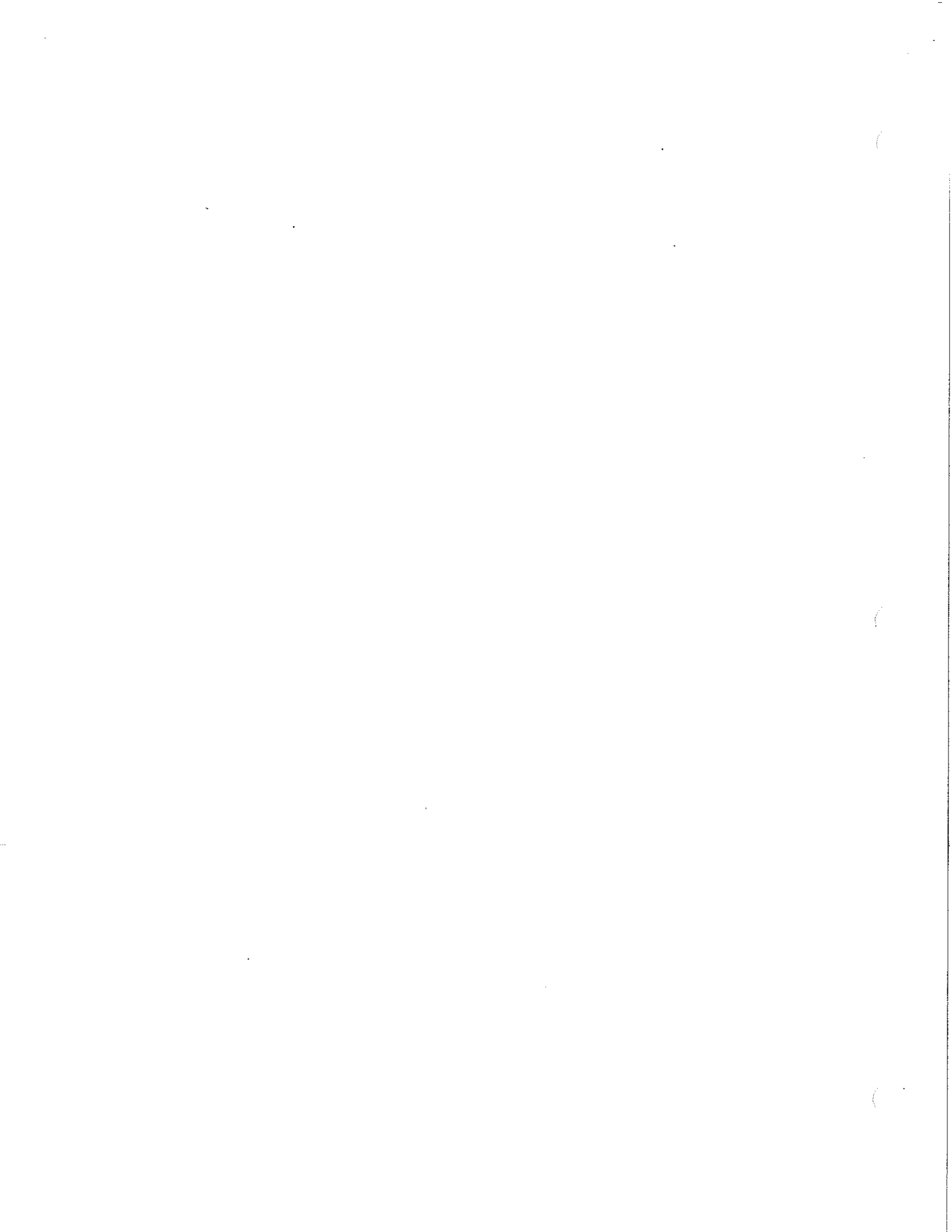
WDMA Window & Door Manufacturers Associations
1400 W. Touhy Avenue, Suite 470
Des Plaines, IL 60018

WWPA Western Wood Products Association
522 SW Fifth Avenue, Suite 500
Portland, OR 97204-2122

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION 01090



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SECTION 01340 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

- A. Submit shop drawings, product data and samples as required by the Contract Documents. Individual submittal requirements are specified in applicable sections for each unit of work. Receive, check and coordinate all submittals of contractors as provided herein.

- B. Definitions:

1. Shop Drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or any subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.
3. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged.

1.03 SUBMITTAL REQUIREMENTS:

- A. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for the same work, and for interfacing units of work, so that one will not be delayed for coordination with another. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.

- B. Submit one reproduction transparency and the two (2) prints of each shop drawing, including fabrication, erection, layout and setting drawings and such other drawings as required under various sections of the Specifications, until final acceptance is obtained. Prepare drawings legible, drawing plans, elevations, sections and details in scales required and on drawing sheets not larger than 30" x 42" nor smaller than 24" x 30". Submit copies of manufacturer's descriptive data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules, and other pertinent information as required. Where printed materials describe more than one product or model, clearly identify which is to be furnished.
- C. Shop drawings, product data and samples shall be dated including Contractor and Subcontractor dates of submittal and approval, and marked to show the names of the Project, Architect, Contractor, origination Subcontractor, manufacturer or supplier, and separate detailer if pertinent. Shop drawings shall completely identify Specification section and locations at which materials or equipment are to be installed. Reproductions of Contract Drawings are acceptable as Shop Drawings only when specifically authorized in writing by the Architect.
- D. Submission of shop drawings, product data and samples shall be accompanied by a copy of a transmittal letter containing Project name, Contractor's name, number of drawings, and samples, titles and other pertinent data. Transmittal shall bear signature of the Contractor as evidence he checked same and found them in conformance with the Contract Documents.
- E. The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data and Samples required by the Contract Documents.
- F. By approving and submitting Shop Drawings, Product Data and Samples, the contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

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- G. The Contractor shall not be relieved of responsibility for the deviation from the requirements of the Contract Documents by the Architect's acceptance of Shop Drawings, Product Data or Samples under Paragraph 3.12 of the General Conditions, unless the Contractor has specifically informed the Architect in writing of such deviation at the time of subdeviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the Architect's acceptance thereof.
- H. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Architect on previous submittals.
- I. No portion of the Work requiring submission of a Shop Drawing, Product Data or Sample shall be commenced until the submittal has been accepted by the Architect as provided in Paragraph 3.12 of the General Conditions. All such portions of the Work shall be in accordance with approved submittals.
- J. Architect will review Shop Drawings, Product Data and Samples as provided in Paragraph 3.12 of the General Conditions. He will mark each such submittal as follows:
1. No Exceptions Taken - Where no comment made.
 2. Note Markings - Where comments indicated on submittal qualifying, modifying, or otherwise changing it; however, submittal can be used for ordering, fabrication and erection at contractor's own risk until revised submittals have been made, reviewed and stamped acceptable.
 3. Rejected/Resubmit - Submittal not in conformance; revise and resubmit. Acceptance does not authorize any changes in the Contract Documents unless specifically stated in a separate letter or change order.
- K. Contractor is responsible for obtaining and distributing required prints of shop drawings to his subcontractors and material suppliers; after as well as before final approval. Prints of reviewed shop drawings shall be made from transparencies which carry the Architect's appropriate stamp.

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- L. Obtain copies of all shop drawings, product data and samples submitted to date and accepted from other contractors.

PARTS 2 and 3 - PRODUCT AND EXECUTION

Not applicable.

END OF SECTION 01340

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SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

- A. Specific quality control requirements for the work are indicated throughout the contract documents. The term "Quality Control" includes, but is not necessarily limited to, inspection and testing and associated requirements. This section does not specify or modify Architect's duties relating to quality control and Contract enforcement.
- B. Coordinate quality control programs of separate contractors including submittals, conferences and on site programs.

1.03 RESPONSIBILITY:

- A. Residual Contractor Responsibility: Whatever required, inspection, testing and similar quality control provisions to be performed by independent agencies (not directly by the Contractor), and not indicated to be Owner's responsibility, shall be the Contractor's responsibility. The costs for those required services by independent testing laboratories are recognized to be included in Contract Sum.
- B. Contractor's General Responsibility: No failure of test agencies, whether engaged by Owner or Contractor, to perform adequate inspections or tests or to properly analyze or report results, shall relieve Contractor of responsibility for fulfillment of requirements of contract documents. It is recognized that required inspection and testing program is intended to assist the Contractor, Owner, Architect, and governing authorities in nominal determination of probable compliances with requirements for certain elements of work. The program is not intended to limit the Contractor's regular quality control program, as needed for general assurance of compliances.

1.04 QUALITY ASSURANCE:

- A. General Workmanship Standards: Comply with recognized workmanship quality standards within the industry as applicable to each unit of work, including ANSI standards where applicable. It is a requirement that each category of trades person or installer performing the work be prequalified, to the extent of being familiar with applicable and recognized quality standards for that category of work, and being capable of workmanship complying with those standards.
- B. Qualification of Quality Control Agencies: Except where another qualification standard is indicated, and except where it is specifically indicated that use of prime product manufacturer's test facilities is acceptable, engage independent testing laboratories complying with "Recommended Requirements for Independent Laboratory Qualifications" as published by American Council of Independent Laboratories, and specializing in type(s) of inspections and tests required.

1.05 SUBMITTALS:

- A. General: Refer to Section 01340, Shop Drawings, Product Data and Samples for requirements applicable to inspection and test reports, quality control samples, maintenance agreements, warranties, and similar documentation of quality compliances as required. Refer to individual work sections of Division 2 through 16 for specific certification and submittal requirements.
- B. Copies and Distribution: Where inspection and test reports and certifications are required by governing authorities, provide additional copies as required, and where required, send copies directly from inspection or testing agency to governing authority.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. General: Handle, store and protect materials and products, including fabricated components, by methods and means which will prevent damage, deterioration and losses including theft (and resulting delays), thereby ensuring highest quality results as performance of the work progresses. Control delivery schedules so as to minimize unnecessary long-term storage at project site prior to installation.

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PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION:

3.01 PREPARATION FOR INSTALLATION:

- A. Pre-Installation Conferences: Well in advance of installation of every major unit of work which requires coordination with other work, meet at the project site with installers and representatives of manufacturers and fabricators who are involved in or affected by the unit of work, and in its coordination or integration with other work which has proceeded or will follow. Advise Architect and Owner of scheduled meeting dates. At each meeting, review progress of other work and preparations for particular work under consideration, including requirements of contract documents, options, related change orders, purchases, deliveries, shop drawings, product data, quality control samples, possible conflicts, compatibility problems, time schedule, weather limitations, temporary facilities, space and access limitations, structural limitations, governing regulations, safety, inspection and testing requirements required performance results, recording requirements, and protection. Record significant discussions of each conference, and agreements and disagreements along with final plan of action. Distribute record of meeting promptly to everyone concerned, including Architect and Owner.
1. Do not proceed with the work if associated pre-installation conference cannot be concluded successfully. Instigate actions to resolve impediments to performance of the work, and reconvene conference at earliest date feasible.
- B. Installer's Inspection of Conditions: Require Installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

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3.02 COORDINATION OF TEST AGENCY WORK:

A. Coordination with Owner's Agencies: Afford access and reasonable time in construction sequence for Owner's inspection and tests to be performed. Cooperate with agencies and provide incidental labor and services needed for the removal and delivery of test samples, and for inspections and taking measurements. Provide patching and restoration services where test samples have been removed, complying with individual technical sections of Divisions 2 through 16.

1. Except for specialized laboratory sampling equipment, and except as otherwise indicated, supply and operate tools and construction equipment needed to obtain test samples from the work, including cutting devices for sawing, drilling, flame-cutting, coring and similar operations. Assist agencies in labeling and packing of test samples removed from the work.

B. Coordination with Contractor's Independent Agencies: Except for required independent agency activities of inspection, measuring, testing, analyzing, reporting and similar activities, the assignment of labor, equipment, cutting, Patching and similar necessary activities associated therewith are Contractor's option recognizing that entire activity is Contractor's responsibility.

C. Test Agency Responsibilities:

1. Test agencies, regardless of whether engaged by Owner or Contractor, are not authorized to change or negate requirements of Contract Documents. Each agency shall coordinate its assigned work with construction schedule as maintained by Contractor, and shall perform its work promptly so as not to delay the work. Observances (by agencies) having a bearing on the work shall be reported to Architect in most expeditious way possible, and shall be recorded in writing by agency. Agency personnel shall not interfere with or assume duties of Contractor.

2. Reports: The testing agency shall prepare reports of inspections and laboratory tests, including analysis and interpretation of test results where applicable. Properly identify each report and, where required, provide agency's certification of test results. Describe test methods used, and compliance with recognized test standards (if any). Complete and submit report at earliest possible date in each case.

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3.03 INSTALLATION QUALITY CONTROL:

- A. Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicate in contract documents.
- B. Inspect each item of materials or equipment, immediately prior to installation, and reject damaged and defective items.
- C. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerances, if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual effect choices to Architect for final decision.
- D. Recheck measurements and dimensions of the work, as an integral step of starting each installation.
- E. Install work during conditions of temperature, humidity, exposed, forecasted weather, and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
- F. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.
- G. Mounting Heights: Except as otherwise indicated, mount individual units of work at industry-recognized standard mounting heights, for applications indicated. Refer questionable mounting height choices to Architect for final decision.
- H. Adjust, clean, lubricate, restore, marred finished, and protect newly installed work, to ensure that it will remain without damage or deterioration during the remainder of construction period.

END OF SECTION 01400

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SECTION 01700 - PROJECT CLOSEOUT

PART ONE - GENERAL

1.01 CLEANING

- A. Prior to Final Acceptance of the entire work, and at such times as directed by the Owner's Representative, the Contractor shall thoroughly clean all exposed surfaces of the building relating to the Work of the Contract.
- B. Prior to such Final Acceptance, all protective coatings except lacquers shall be removed from finish surfaces, and all glass of the work shall be washed and cleaned.
- C. The Contractor shall be held responsible for all damaged materials, which shall be replaced at completion at no cost to the Owner. Glass, tile and aluminum scratched through carelessness or improper cleaning shall be considered damaged and shall be replaced.

1.02 INSTALLATION AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall present to the Owner's Representative three (3) duplicate sets of the manufacturer's installation and maintenance instructions for each and every item furnished or erected.
- B. In each of these, the correct model number and the data for the model number shall be checked off in ink where the literature covers more than one model number.

1.03 ADJUSTMENTS

The complete installation consisting of the several parts and systems and all equipment installed according to the requirements of the Specifications and as shown on the Drawings shall be adjusted as required and ready in all respects for use by the Owner at the time of Final Acceptance of the Work.

END OF SECTION 01700

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SECTION 01800 - GUARANTEE - WARRANTY

PART ONE - GENERAL

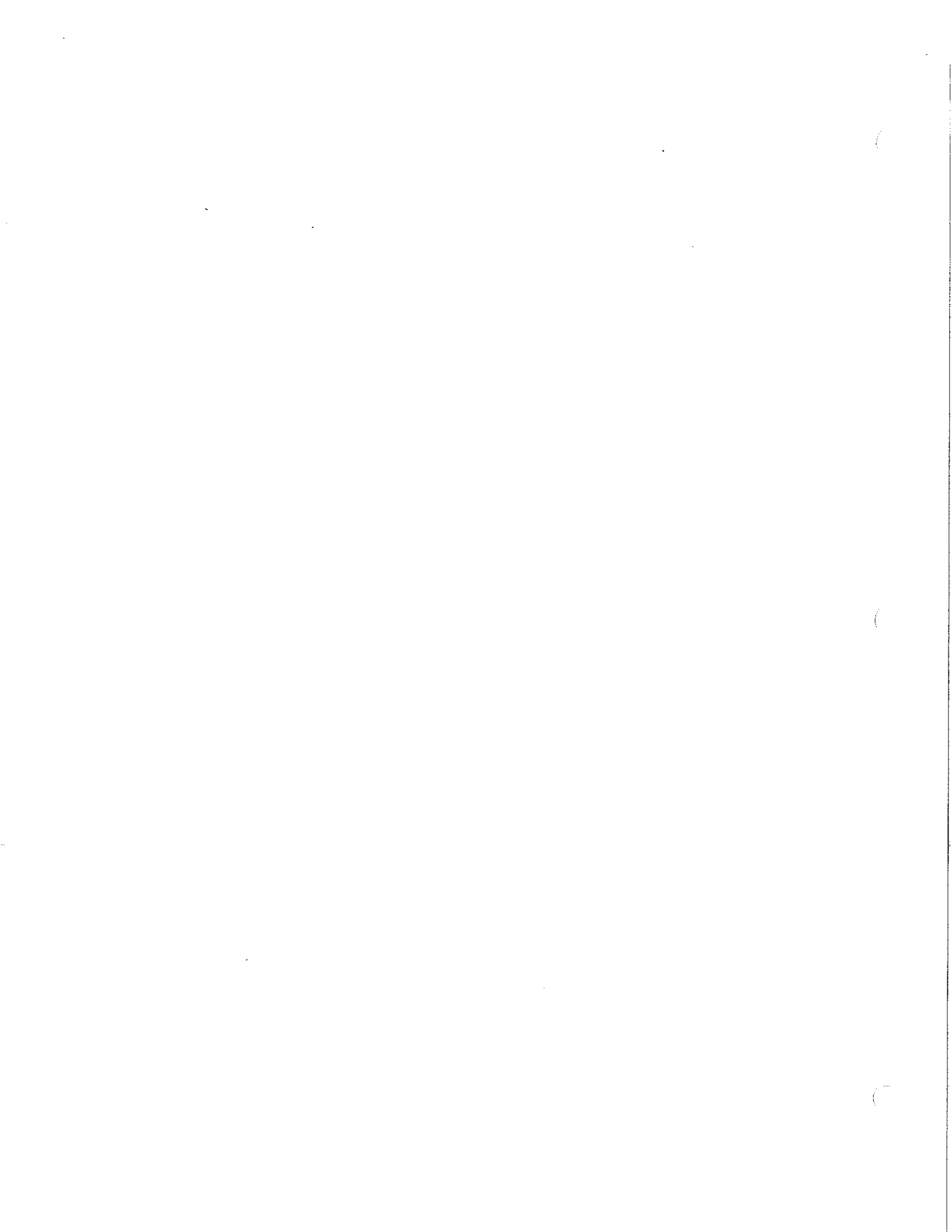
1.01 GUARANTEE PERIOD

The General Contractor shall and hereby does guarantee and warrant that all work for this building, under this Contract, shall be free from defects or faulty labor and/or materials for a period of **two (2) years** from the date of Final Acceptance of same, except when longer periods are herein specified, which develop within any guarantee periods.

1.02 FINAL PAYMENT

Final payment is contingent upon the Owner's Representative's receipt of such guarantees and/or warranties from the General Contractor.

END OF SECTION 01800



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SECTION 02000
BID CATEGORY - 02000 GENERAL TRADES

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all General Trades in accordance with the specifications, drawings, and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

<u>Specification</u>	<u>Section</u>	<u>Description of Section</u>	
<u>DIVISION 2</u>	<u>SITE</u>		
	02070	Selective Demolition	6
	02300	Earthwork	13
	02925	Cleanup and Restoration	2
<u>DIVISION 3</u>	<u>CONCRETE</u>		
	03001	Concrete Work	15
<u>DIVISION 5</u>	<u>METALS</u>		
	05120	Structural Steel	10
	05500	Metal Fabrications	8
<u>DIVISION 6</u>	<u>WOOD AND PLASTICS</u>		
	06100	Carpentry	6
<u>DIVISION 7</u>	<u>THERMAL AND MOISTURE PROTECTION</u>		
	07910	Joint Fillers and Gaskets	5
	07920	Sealants and Caulking	12
<u>DIVISION 8</u>	<u>DOORS AND WINDOWS</u>		
	08112	Hollow Metal Work	10
	08210	Wood Doors	7
	08710	Finish Hardware	18
	08800	Glass & Glazing	14
	08810	Fire Rating Glass & Framing System	9
<u>DIVISION 9</u>	<u>FINISHES</u>		
	09250	Gypsum Drywall	17
	09510	Acoustical Ceilings	5
	09650	Resilient Flooring	6
	09900	Painting	11
<u>DIVISION 10</u>	<u>SPECIALTIES</u>		
	10522	Fire Extinguishers and Cabinets	2
	10800	Toilet Accessories	7

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In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirement and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review all drawings and drawing notes, including architectural, mechanical and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
2. This contractor will be responsible for all re-mobilization costs for all phases of work.
3. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
4. Coordination with other trades, including mandatory participation in job meetings.
5. Coordinate the location and sizes of all openings with the appropriate trades.
6. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used to the Architect.
7. Referencing drawing A1.0-Demo Plan Notes: This contractor is responsible for work described in the following notes: 1, 4, 9. New work plan notes: 1, 3, 6, 7, 8, 9. Reflected ceiling plan notes: 2, 3, 4. Composite Plan notes: 1, 2, 3, 4, 5, 6.
8. Reference drawings No. A2.0 - this contractor is responsible for work described in the following notes: Demolition plan notes: 1, 2, 3, 8, 9, 10, 11, 12, 13, 15. New work notes: 1 thru 11. Reflected ceiling plan notes: 1, 4. Roof framing plan notes: 1, 2, 3, 4. Roof plan notes: 1, 2, 3, 4, 5, 6, 7, 11.
9. Perform all demolition work as described on the Demolition Drawings and noted in the Demolition Notes.

10. Furnish, install and maintain all shoring and bracing as required. Leave shoring in place until new building systems are in place and then remove as required. Prior to installation of shoring and bracing efforts, provide shop drawings on the proposed shoring and bracing design. A registered engineer in the State of Michigan must seal drawings.
11. Perform all trimming and adjusting of demolition work for installation of new construction. Coordinate limits of wall demolition with architectural drawings and all critical trade contractors.
12. In all locations where this contractor sawcuts the floor, this same contractor is also responsible for pouring back concrete. This contractor must coordinate with flooring contractor as to provide proper floor finish and height.
13. Fabrication and installation of all structural steel framing, columns, beams, girts, sag rods, joists and girders, metal decking, bracing, connections, steel tube framing, roof ladders, staircases, wall ladders, pipe railings, temporary bracing and erection materials, miscellaneous support steel and miscellaneous iron, as specified.
14. Furnish all loose steel lintels, shelf angles, anchor bolts, masonry anchors, set irons, bearing plates, leveling plates, sleeves, and relief angles to the appropriate trades for installation.
15. Furnish and install roof guardrail shown on drawings.
16. This contractor is responsible for proper storage and protection of steel from corrosion, deformation and other damage on site.
17. Include cleaning and touch up painting of bolted connections, welded connections, and abraded areas. After erection, field coat all abrasions, nuts and bolts, washers and surfaces left unpainted. Shop paint all steel members.
18. Provide steel framing for all roof deck penetrations including but not limited to ductwork and exhaust fans. Other trades will be required to locate and make penetrations and cover and protect those penetrations.
19. Coordinate with other trades, which may require holes or special anchorage to steel members.

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20. Coordinate all wood doors and hollow metal frames including all finish hardware and related items as required.
21. Contractor will be responsible for delivery and off-loading of all hollow metal frames at the site.
22. Supply and install cylinders capable of receiving the cores which match the owner's keying systems. Cores to be supplied by owner.
23. Remove tags and clean all surfaces after new doors and panels are installed.
24. Contractor will be responsible for storing all doors and frames in an acceptable manner. Contractor will be responsible for removing any rust which may appear on the steel doors and frames.
25. Provide and install all finish wood trim, woodwork and millwork, shelving and all other finish carpentry, as specified.
26. Provide and install all insulation required for this contractors work.
27. Provide all backing, wood blocking and shims for proper anchorage, as required, for work of this category and others, to include specialties, countertops, wood trim work, toilet accessories, and equipment.
28. Provide and install complete gypsum wallboard, cement board, framing, layout, insulation backing, drip edges, metal edge angles, sealants, expansion joint assemblies, backer rods, through-wall flashing, control joints, including all accessories. This contractor is responsible for providing final wall construction to meet code requirements.
29. Provide and install complete cold-formed metal framing system (interior and exterior) including design and engineering, as specified.
30. Provide labor and material to perform all taping, sanding and finishing of drywall and plaster surfaces to degree ready for acceptance of final wall treatment and obtain approval for application of all finishes.
31. Provide and install all insulation, sealers, vapor barriers and soundproofing material behind work of this category, and all exterior walls and soffits to receive blanket insulation.

32. Seal drywall partitions up against structural steel or deck and provide fire safing materials to close all penetrations through partitions, as specified. Sealing of drywall walls shall meet all fire rating codes.
33. Contractor is responsible for repairing areas where nailpops, ridging, etc., occurs or openings in drywall for backboxes are too large for cover trim or plate.
34. Coordinate all embedded items incorporated in this work including, but not limited to, mechanical and electrical equipment for proper alignment leveling and access.
35. Provide and install complete acoustical ceiling system including all framing, layout, insulation, backing, ceiling tiles, break metal closures, anchorage and hangers. Coordinate layout of mechanical and electrical fixtures with those trades. Complete all mechanical/electrical cuts required by other trades.
36. This contractor is responsible for re-working the ceiling grid for the installation of their own work.
37. Provide and install additional support members and furring channels for hangers required to support their own work around mechanical and electrical fixtures; including the condition when it is necessary to span ducts, pipes and structural members.
38. Provide all light gauge metal framing required for interior and exterior construction and accessories including but not limited to parapets, as specified.
39. This contractor will provide positive water seals throughout the entire construction period, so as not to allow damage to new or existing construction. If water or any other type of damages occur due to elements entering through any roof opening it will be this contractors responsibility to bare the cost of the repair or replacement to the damaged construction.
40. All roofing work shall be performed by owners contractor.
41. Install all roof curbs provided by category 15000, refer to mechanical plans for locations and sizes of roof openings. This contractor shall create the new roof openings (cutting thru but not limited to roofing materials, decking, etc.) in existing roof.

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EXCLUDED FROM THIS CONTRACTORS WORK IS:

1. All required testing (By Owner)

END OF BID CATEGORY 02000 GENERAL

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SECTION 02000
BID CATEGORY - 15000 MECHANICAL

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all Mechanical Work in accordance with the specifications, drawings, and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

<u>Specification Section</u>	<u>Description of Section</u>	
<u>DIVISION 2</u>	<u>SITE</u>	
02070	Selective Demolition	6
02300	Earthwork	13
02925	Cleanup and Restoration	2
<u>DIVISION 11</u>	<u>EQUIPMENT</u>	
11400	Food Service Equipment	52
<u>DIVISION 15</u>	<u>MECHANICAL</u>	
15010	Mechanical General Requirements	14
15050	Basic Materials & Methods	25
15053	Common Work Results for HVAC	6
15055	Motors	10
15060	Hangers and Supports	20
15075	Mechanical Identification	9
15080	Mechanical Insulation	23
15110	Valves	7
15121	Pipe Flexible Conn./Exp Fitting & Loops	3
15128	Heat Tracing for Plumbing Piping	6
15140	Domestic Water Piping	10
15145	Domestic Water Piping Specialties	7
15150	Sanitary Waste and Vent Piping	9
15155	Drainage Piping Specialties	17
15194	Fuel Gas Piping	10
15410	Plumbing Fixtures	9
15815	Metal Ducts	14
15820	Duct Accessories	10
15838	Power Ventilators	9
15855	Diffusers, Registers & Grilles	3
15860	Environmental Equipment	10
15900	Temperature Controls	13
15950	Testing, Adjusting & Balancing	22

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In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirement and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review all drawings and drawing notes, including architectural, mechanical and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
2. This contractor will be responsible for all re-mobilization costs for all phases of work.
3. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
4. Coordination with other trades, including mandatory participation in job meetings.
5. Coordinate the location and sizes of all openings with the appropriate trades.
6. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used to the Architect.
7. Referencing drawing A1.0-Demo Plan Notes: This contractor is responsible for work described in the following notes: 2, 3, 5, 6. New work plan notes: 2, 4, 5.
8. Reference drawings A-2.0 - this contractor is responsible for work described in the following notes: Demolition plan notes: 4, 5, 6, 7, 14, 17. Reflected ceiling plan note: 3. Roof framing plan notes: 2, 8, 9, 10, 12.
9. Reference all mechanical drawings (M0.1 thru M7.2) and FSE Drawings (FSE-1 thru FSE-5). This contractor is responsible for all demo notes and new work notes on all mechanical drawings and all FSE drawings.

10. Furnish, install and maintain all shoring and bracing as required. Leave shoring in place until new building systems are in place and then remove as required. Prior to installation of shoring and bracing efforts, provide shop drawings on the proposed shoring and bracing design. A registered engineer in the State of Michigan must seal drawings.
11. Perform all trimming and adjusting of demolition work for installation of new construction. Coordinate limits of wall demolition with architectural drawings and all critical trade contractors.
12. In all locations where this contractor sawcuts the floor, this same contractor is also responsible for pouring back concrete. This contractor must coordinate with flooring contractor as to provide proper floor finish and height.
13. All required permits, fee applications, etc., required for execution of the work as required by code and local authorities shall be included in this bid. This shall include all city, township, gas company and/or other fees related to this contractors work.
14. Coordinate and schedule utility shut-downs as required for this contractors work with Owner.
15. This contractor is responsible for all rigging and hoisting, as required for their work.
16. The first floor sub-grade will be placed and compacted prior to the start of the underground work designated in this package. This contractor is responsible to excavate, install work and replace all fill to the specified density material within the building interior to the same condition it was prior to starting excavation for underground.
17. Contractor is responsible for all excavation, underground piping, backfill and compaction for their work. All backfill must be Class II granular fill.
18. Contractor is responsible for removal of all spoils resulting from their work from the site.
19. This contractor is to verify and stake locations of all underground utilities before beginning their work.
20. Coordinate with Architect/Engineer before penetrating any structural members.

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21. Provide mechanical identifications for all pipes and valves including a valve schedule.
22. This contractor is responsible for covering and securing, water-tight, all existing curbs on roofs that are to be removed and any of their own new through-floor or roof penetrations.
23. Supply and install all temperature controls including all related wiring and equipment, as specified.
24. In rooms where existing ceiling is not scheduled to be removed and replaced, this contractor will be responsible for removal and replacement of ceiling tile as required to perform their work, as well as any cost associated with replacing with new tiles.
25. Provide and locate all roof curbs or penetrations for mechanical equipment. Contractor will level all curbs, as specified. If roof curbs are not onsite at the time the roof is being installed, this contractor will be responsible for any additional charges incurred by the roofing contractor to flash in said units. Roof flashing at new curbs are to be done by owner's contractor.
26. This contractor is responsible for all sheet metal work, piping and mechanical equipment required for the complete heating and cooling system including but not limited to: AHU's, EF's, grilles, diffusers, pumps, valves, and unit heaters. Store, clean and reinstall diffusers unless noted otherwise.
27. This contractor is responsible for all plumbing (sanitary, storm, gas, hot and cold water, refrigerant vent, acid waste, compressed air, and heating/cooling piping), valves, equipment (water heaters, air compressors, etc.), plumbing fixtures, plumbing specialties, food service equipment, and accessories as required.
28. Pressure test all underground pipes as required in the specifications and plumbing codes.
29. This contractor will be required to direct all related trades as to locations and sizes of penetrations to surfaces. If proper coordination is not provided it will be the responsibility of this contractor to cut, patch and revise all holes and penetrations for the installation of all pipe and ductwork. All penetrations through walls, floors, and ceilings will be fire and smoke stopped so as to comply with the local and state requirements.

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30. This contractor is responsible for cutting any required openings in the metal deck as required for their work. Openings shall be kept protected and water-tight.
31. Prior to final acceptance this contractor shall clean all floor drains and associated piping and remove all dirt and debris. Test with running water for good draining after cleaning.
32. Label all mechanical lines, as specified.
33. Provide protection of equipment. Costs incurred due to damage of equipment because of lack of adequate protection will be the responsibility of this contractor. This includes temporarily capping all floor drains and pipes so as to prevent concrete and other construction debris from entering the plumbing.
34. Coordinate layout and installation of all mechanical piping and ductwork with other trades. This contractor is responsible for the proper location and sizes of all mechanical openings by other trades. Any corrective work necessary to wall or floor openings will be the responsibility of this contractor.
35. This contractor is to furnish duct-work coordination drawings to all related trades prior to their work commencing.
36. This contractor is responsible for the insulation of all mechanical and plumbing systems (pipes, fittings, duct, etc.) as required and specified.
37. The contractor is responsible for all caulking, gaskets, and sealing of mechanical and plumbing systems to provide air, water and weather tight connections including but not limited to sealing of wall and floor penetrations and plumbing fixtures.
38. Furnish and install all motors, starters, disconnect switches that are loose from the equipment or part of packaged mechanical equipment that are necessary for the operation and control of all equipment as required. This contractor will be responsible for all supports necessary to mount the above mentioned items. Category 16000 will provide wiring.
39. The contractors field superintendent shall be present during testing and field reviews conducted by the various inspection agencies.

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40. This contractor will be responsible for all de-watering during excavations of their work.
41. It will be the responsibility of this contractor to be onsite during concrete pours to verify levelness and pitch to all floor drains.
42. This contractor will be responsible for all mechanical demolition as shown on drawings. This is to include all pipe, insulation, sheet-metal, mechanical units, etc. this contractor is responsible for all disconnects for their own demolition.
43. Each contractor performing demolition shall be responsible for protecting new and existing construction from damage due to their own work. If any adjacent surfaces are damaged, it will be the sole responsibility of the contractor at fault to completely repair and replace all damaged construction to the satisfaction of the Owner and Architect.
44. This contractor is responsible for the cutting and patching of all existing materials for the installation of all mechanical work. All penetrations through walls and ceilings will be fire and smoke stopped whereas to comply with the State and local Fire Safety Requirements. Provide and install all firestopping materials. Contractor shall restore all surfaces to match existing conditions. This shall include all drywall, masonry, concrete, acoustical ceiling, steel, roofing, windows, insulated wall panels, plaster, flooring (all types), painting, and caulking work.
45. This contractor is responsible for all saw-cutting required for any underground mechanical work in the existing building. Use of Ground Penetrating Radar is mandatory.
46. Provide complete testing, adjusting, and balancing of the mechanical systems, as specified. Provide additional testing at 90 days after completing the TAB, and during near-peak summer and winter conditions.
47. This contractor shall furnish, upon completion of work, as-built mylar drawings showing the installation of the work as completed and operating and maintenance manuals as described in the specifications. Provide certification of system and equipment as specified. Provide training to the Owner's personnel.

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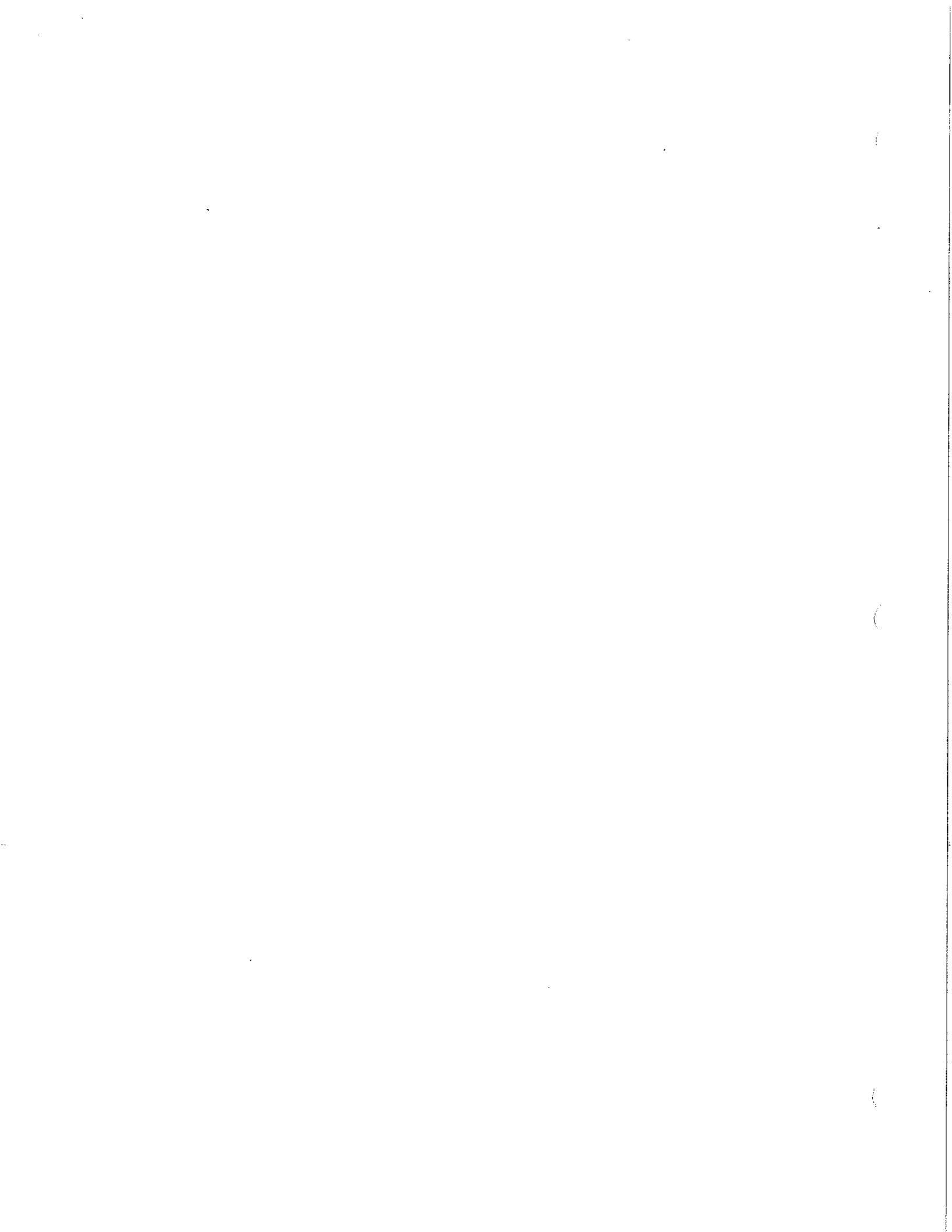
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EXCLUDED FROM THIS CONTRACTORS WORK IS:

1. All required testing (By Owner)

END OF BID CATEGORY 15000 MECHANICAL



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SECTION 02000
BID CATEGORY - 16000 ELECTRICAL

The work of this bid category includes but is not limited to providing all labor, equipment, materials, scaffolding, hoisting and incidentals to complete all Electrical Work in accordance with the specifications, drawings, and applicable codes. All work is to be performed as shown on the plans and specified in the following technical specification sections:

<u>Specification Section</u>	<u>Description of Section</u>	
<u>DIVISION 2</u>	<u>SITE</u>	
02070	Selective Demolition	6
02925	Cleanup and Restoration	
02300	Earthwork	
<u>DIVISION 16</u>	<u>ELECTRICAL</u>	
16010	Electrical General Requirements	15
16050	Basic Elec'l Materials & Methods	5
16055	Overcurrent Protective Device	
	Coordination and Arch Flash Study	13
16060	Grounding and Bonding	10
16073	Hangers & Supports for	
	Electrical Systems	7
16075	Electrical Identification	10
16120	Conductors & Cables	7
16130	Raceways and Boxes	10
16140	Wiring Devices	10
16145	Lighting Control Devices	9
16410	Enclosed Switches & Circuit Breaker	9
16420	Enclosed Controllers	11
16442	Panelboards	10
16491	Fuses	5
16511	Interior Lighting	23
16721	Fire Alarm	20

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In addition to the above, this bid category includes but is not limited to the Bidding Documents, the Bidding and Contract requirement and Division 1 General Requirements of the Project Manual and various other Technical Specifications interfacing with this work. The bidder is advised to review the work descriptions of the other categories and other referenced documents so as to not misunderstand scope responsibilities.

THE SCOPE OF THIS BID CATEGORY SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING ITEMS:

1. It is the responsibility of this Bid Category to review all drawings and drawing notes, including architectural, mechanical and electrical drawings, and include items requiring work that is generally defined as the responsibility of this Bid Category within the work description unless otherwise noted above in the scope of work.
2. This contractor will be responsible for all re-mobilization costs for all phases of work.
3. This contractor is to provide all legal disposal off-site of the debris that is a result of their work.
4. Coordination with other trades, including mandatory participation in job meetings.
5. Coordinate the location and sizes of all openings with the appropriate trades.
6. Before sawcutting or making any cuts in the floor, all contractors must use ground penetrating radar, and must provide proof that it was used to the Architect.
7. Referencing drawing A-1.0-Reflected Ceiling Plan Notes: This contractor is responsible for work described in the following notes: 1. Composite Plan notes: 7, 8, 9, 10.
8. Reference drawings A-2.0 - this contractor is responsible for work described in the following notes: Reflected ceiling plan note: 2. Demolition plan notes: 3.
9. Reference all electrical drawings (E0.1 thru E7.1). This contractor is responsible for all demo notes and new work notes on all mechanical drawings. Refer also to electrical rough-in notes on sheet FSE-2.
10. Furnish, install and maintain all shoring and bracing as required. Leave shoring in place until new building systems are in place and then remove as required. Prior to installation of shoring and bracing efforts, provide shop drawings on the proposed shoring and bracing design. A registered engineer in the State of Michigan must seal drawings.
11. Perform all trimming and adjusting of demolition work for installation of new construction. Coordinate limits of wall demolition with architectural drawings and all critical trade contractors.

12. In all locations where this contractor sawcuts the floor, this same contractor is also responsible for pouring back concrete. This contractor must coordinate with flooring contractor as to provide proper floor finish and height.
13. Coordinate and schedule utility shut-downs as required for this contractors work with Owner.
14. Obtain approvals, permits and coordinate the inspection and testing of the systems with state governing agencies. This contractor is responsible for and shall coordinate all work with public utility companies, as required. Pay for all fees and testing charges for each system.
15. This contractor will be responsible for all de-watering during excavations of their work.
16. This contractor will provide all temporary lighting and power as specified in the Special Conditions.
17. The contractors field superintendent shall be present during testing and field reviews conducted by the various inspection agencies.
18. This contractor will be responsible for all hoisting and handling necessary to complete this work.
19. This contractor shall provide rough-ins and final electrical connections for mechanical and electrical equipment, specialties, and casework, as specified. Coordinate with other trades to provide all required electrical connections. Furnish and install all electrical equipment and accessories as related to other trades.
20. The first floor sub-grade will be placed and compacted prior to the start of the underground work designated in this package. This contractor is responsible for all layout, excavation, backfilling, and compaction for any underground or underfloor electrical work required. Replace all fill to the specified density following excavation for the work of this category.
21. Contractor is responsible for removal of all spoils resulting from their work from the site.
22. Verify and stake locations of all underground utilities before work begins.
23. Coordinate with Architect/Engineer before penetrating any structural members.
24. Provide proper identification of panels, circuits and systems.
25. Furnish and install all specified backing and supports for fixtures and equipment.
26. This contractor will provide all conduit, wiring, panels, devices, switches and accessories necessary for the installation of a complete power system.
27. Coordinate installation of electrical floor boxes with category 15000. This contractor will be responsible for proper layout of the boxes.

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28. Provide all required escutcheons, pedestals, etc. for finish trim for this scope of work, as specified.
29. Provide and locate all access doors to architectural trades for setting as required for access to electrical equipment.
30. This contractor is to wire all motors, disconnect switches, and starters supplied by either themselves or category 15000.
31. Provide and install all conduits, raceways and boxes for telephone and computer (data) system. This contractor must coordinate with the Owner's representative as to size and type of equipment.
32. Provide and install complete fire alarm system as described in the technical specifications, shown on the drawings, and required to meet applicable codes and regulations. Coordinate all fire alarm work with mechanical contractor's work to provide all required safety and emergency shutdown features.
33. This contractor will be responsible to provide and install smoke detectors to the building fire detection system and electrical service.
34. This contractor is responsible for the cutting and patching of all existing materials for the installation of all electrical work. All penetrations through walls and ceilings will be fire and smoke stopped whereas to comply with the State and local Fire Safety Requirements. Provide and install all firestopping materials. Contractor shall restore all surfaces to match existing conditions. This shall include all drywall, masonry, concrete, acoustical ceiling, steel, roofing, windows, insulated wall panels, plaster, painting, and caulking work.
35. Provide and install all clocks, integrated intercom/telecommunications, sound system, and connections to projection system equipment as shown and specified, including all related materials.
36. Provide protection of equipment. Damage to equipment due to a lack of adequate protection will be the responsibility of this contractor.
37. Provide complete lighting system with occupancy and/or automated lighting controls, as required.
38. Each contractor performing demolition shall be responsible for protecting new and existing construction from damage due to their own work. If any adjacent surfaces are damaged, it will be the sole responsibility of the contractor at fault to completely repair and replace all damaged construction to the satisfaction of the Owner and Architect.

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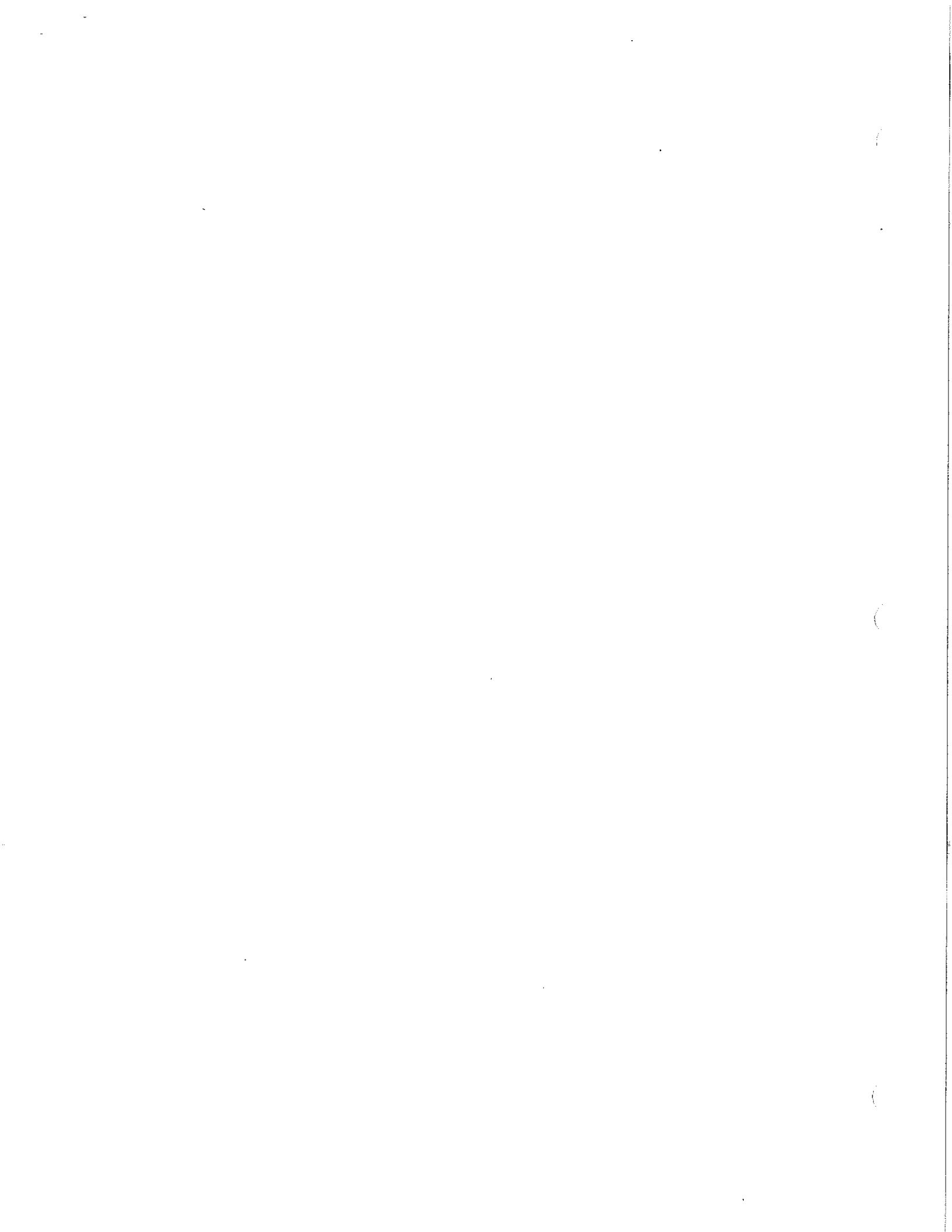
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39. This contractor will be responsible for all electrical demolition as shown on drawings. This is to include all conduit, wiring, light fixtures, etc. This contractor is responsible for all disconnects for their own demolition as well as disconnects of the existing mechanical and kitchen equipment.
40. In rooms where existing ceiling is not scheduled to be removed and replaced, this contractor will be responsible for removal and replacement of ceiling tile as required to perform their work, as well as any cost associated with replacing with new tiles.
41. This contractor shall furnish, upon completion of work, as-built mylar drawings showing the installation of the work as completed and operating and maintenance manuals as described in the specifications.

EXCLUDED FROM THIS CONTRACTORS WORK IS:

1. All required testing (By Owner)

END OF BID CATEGORY 16000 MECHANICAL



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SECTION 02070 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section requires the selective removal and subsequent offsite disposal of the following:
 - 1. Removal of portion of existing walls, floors, ceilings and related accessories as indicated on drawings and specifications.
 - 2. Removal of existing HVAC, electrical systems, food service equipment, plumbing fixtures, doors, frames, casework, etc. as indicated on drawings and specifications.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Schedule indicating proposed sequence of operations for selective demolition work to the Architect for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
- C. Photographs of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations are to be filed with the Architect prior to the start of work.

1.4 JOB CONDITIONS

- A. 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

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demolition activities that will affect Owner's normal operations.

- B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, minor variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
- C. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.
 - 1. Storage or sale of removed items on site will not be permitted.
- D. Protections: Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury due to selective demolition work.
 - 1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to occupied portions of building.
 - 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 - 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 - 4. Protect floors with suitable coverings when necessary.
 - 5. Construct temporary minimum one hour fire rated, 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.

6. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
 7. Remove protections at completion of work.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
- F. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- G. 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.
- H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
1. 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.
 2. Maintain fire protection services during selective demolition operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

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1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.

1. Cease operations and notify the Architect and 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 minimum one hour fire rated dust-proof partitions and closures as required to prevent spread of dust or fumes to occupied portions of the building.
 - a. Where selective demolition occurs immediately adjacent to occupied portions of the building, construct dust-proof partitions of minimum 4-inch studs, 5/8-inch drywall (joints taped) on occupied side, 1/2-inch fire-retardant plywood on demolition side. Fill partition cavity with sound-deadening insulation.
 - b. Provide weatherproof closures for exterior openings resulting from demolition work.
4. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.
 - a. 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.

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3.2DEMOLITION

- A. 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.
1. 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.
 2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.
 3. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
 4. Demolish foundation walls to a depth of not less than 12 inches below existing ground surface, or as required for new construction unless noted otherwise on drawings. Demolish and remove below-grade wood or metal construction. Break up below-grade concrete slabs.
 5. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.
- B. 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 Construction Manager and Architect in written, accurate detail. Pending receipt of directive from Construction Manager and Architect, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.3SALVAGED MATERIALS

- A. Salvaged Items: Where indicated on Drawings as "Salvage - Deliver to Owner," carefully remove indicated items, clean, store, and turn over to Owner and obtain receipt.

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1. Historic artifacts, including cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historic significance, remain property of Owner. Notify Architect if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from building site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose off site.
 1. 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.
 2. Burning of removed materials is not permitted on project site.

3.5 CLEANUP AND REPAIR

- A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean.
 1. 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 02300 - EARTHWORK

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. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
 2. Excavating and backfilling for buildings and structures.
 3. Proof-rolling subgrade.
 4. Granular fill course for slabs-on-grade.
 5. Base course for concrete walks and pavements.
 6. Excavating and backfilling trenches within building lines.
 7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures is work of Divisions 15 and 16. This section sets forth the requirements of such work.

1.3 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Layer placed between the subgrade and asphalt or concrete paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Compacted: Material at the required compaction or higher.
- F. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Maximum Density: The dry density at optimum moisture content in accordance with ASTM D1557 (Modified Proctor).
- I. Required Compaction: The ratio of in-place density to maximum density, expressed as a percentage.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
1. Comply with Michigan Department of Transportation (MDOT), 2003 Standard Specifications for Construction.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the Owner and Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Construction Manager not less than 72 hours in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Construction Manager's written permission.
 3. Contact MISS DIG before excavating.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3

inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Base: Naturally or artificially graded mixture of natural or crushed gravel or crushed stone complying with MDOT Table 902-1 21AA Dense Graded Aggregate.
- F. Engineered Fill: Granular soil material complying with MDOT Table 902-1, Class II Granular Material.
- G. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Granular Fill: Granular soil material complying with MDOT Table 902-1, Class II Granular Material.
- I. Pea Gravel: Clean, hard, durable, free flowing, naturally rounded particles of rock, free from clay lumps, with 100% passing a 3/8" sieve and not over 5% passing a #8 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Subgrade is prone to disturbance during construction operations. Subgrade soils may also become disturbed due to ponding water and channeled construction traffic. Disturbed subgrade soils must be properly improved prior to floor slab and pavement construction or placement of engineered fill.

3.2 PROOF-ROLLING

- A. After stripping of topsoil and other surface organic matter and deleterious material and before further excavation, proof-roll entire building pad area to locate overly loose or soft areas and to compact the surface.
 - 1. Subgrade resulting from topsoil and organic material removal shall be thoroughly proof-rolled with fully loaded tandem-axle dump truck or other suitable piece of pneumatic-tired construction equipment. Proof-roll a minimum of ten passes in each of perpendicular direction.
- B. Areas of unsuitable subgrade shall be dried and recompacted in-place or remove and replaced with engineered fill.
- C. Special care shall be exercised when proofrolling adjacent to the existing building to minimize disturbance to existing footings and floor slabs.
 - 1. Use light proofrolling equipment for a strip approximately ten (10) feet wide along the existing building.
- D. Prior to concrete slab placement the prepared subgrade shall again be thoroughly proof-rolled. Disturbed areas shall be recompacted or removed and replaced with engineered fill.
- E. Proof-rolling operations must be done in presence of the Testing Agency.

3.3 DEWATERING

- A. Subgrade soils are prone to disturbance due to ponded water.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

3.7 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines based on the Testing Agency's recommendation that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including but not limited to perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Inspecting and testing underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.

3.10 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Place and compact initial backfill of base course material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- D. Coordinate backfilling with utilities testing.
- E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- F. Place and compact final backfill of satisfactory soil material to final subgrade.

- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use granular fill or approved engineered fill as indicated on drawings.
 - 3. Under steps and ramps, use approved engineered fill.
 - 4. Under building slabs, use approved engineered fill.
 - 5. Under footings and foundations, use approved engineered fill.

3.12 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. In general, the areas within the limits of buildings shall be rough graded to elevations 4" below bottom of slabs, filled with granular material as specified and finish graded to elevations at bottom of slabs.
 - 2. Provide a smooth transition between adjacent existing grades and new grades.
 - 3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.15 BASE COURSES

- A. Under pavements and walks, place base course on prepared subgrade and as follows:
1. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
 2. Shape base to required crown elevations and cross-slope grades.
 3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
 4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.16 GRANULAR FILL COURSE

- A. Under slabs-on-grade, place granular fill course on prepared subgrade and as follows:
1. Compact granular fill course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
 2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
 3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At strip footing subgrades, at least one test each 10 feet o.c of each soil stratum will be performed to verify design bearing capacities.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 25 feet or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 feet or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

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- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300



SECTION 02925 - CLEANUP AND RESTORATION

PART 1 - GENERAL

- A. The Contractor shall restore areas disturbed by construction activities to a condition reasonably close to their condition before the project, unless shown otherwise on the plans. Restoration work should be performed as soon as possible after construction work is completed in a particular area.
- B. Upon the completion of work in an area, all excess materials, debris, equipment, and similar items shall be removed from the project area by the Contractor, and disposed of properly.

PART 2 - MATERIALS

Not Applicable.

PART 3 - EXECUTION

3.01 Restoration

- A. Unless otherwise provided; aggregate surfaces, bituminous pavements, and concrete pavements shall be restored by construction of similar replacement surfaces. Aggregate surfaces shall be replaced with the materials and thicknesses described in the specification for aggregate surfaces. Bituminous pavement shall be replaced with the cross sections(s) shown on the plans and in accordance with the specification for bituminous paving. Concrete pavement shall be replaced with pavement in accordance with the specification for Concrete Driveways and Miscellaneous Pavement.
- B. Turf areas shall be restored by re-establishing the turf as described in the specification for turf establishment. All areas disturbed by construction that are not to be surfaced with aggregate or pavement shall be restored with turf, unless otherwise directed.

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- C. Mailboxes, fences, signs, ornaments, and similar items shall be replaced at the completion of construction. Posts shall be installed plumb. Items that are lost or stolen shall be repaired or replaced at the Contractor's expense. Repairs or replacements shall meet the Owner's approval.

3.02 Temporary Restoration of Driving Surfaces

- A. Where a pavement or gravel surface is removed as a result of construction activities, a temporary surface shall be provided and maintained by the Contractor until the permanent surface is provided. Unless otherwise directed, the temporary surface shall be twelve inches of aggregate compacted to at least 95 percent of its maximum density (ASTM D1557) and graded to meet the adjacent, remaining surfaces. Aggregate shall meet the requirements of Series 23A as described in the 1990 Michigan Department of Transportation Specifications.
- B. The Contractor shall regrade the temporary surface and add additional aggregate at intervals necessary to maintain them in a relatively smooth condition.

END OF SECTION

SECTION 03001 - CONCRETE

PART 1. GENERAL

1.01 RELATED DOCUMENTS

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

- A. Work included in this section includes furnishing all labor, materials, equipment and incidentals required for complete installation of formwork, reinforcement, accessories, cast-in-place concrete, finishing and curing. This section pertains to site and/or building concrete work. This section also includes fill for steel deck and fill for steel pan stairs.

1.03 SUBMITTALS

- A. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Indicate reinforcement sizes, spacings, locations, and quantities, bending and cutting schedules, supporting and spacing devices.
- B. See structural drawings for General Notes and Special Conditions.
- C. Provide data on joint devices, attachment accessories, mix design for each type concrete, proportions of all ingredients, admixtures, slump range, expected strength and water cement ratio. Provide historical test data with each proposed mix design.

1.04 QUALITY ASSURANCES

- A. Building Code Requirements for Structural Concrete (ACI 318) and latest supplements thereto.
- B. Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete (ACI 211.1).
- C. "Hot Weather Concreting" (ACI-305R).

- D. "Cold Weather Concreting" (ACI-306R).
- E. Guide for Measuring, Mixing, Transporting, and Placing Concrete (ACI 304R).
- F. Standard Practice for Curing Concrete (ACI 308).
- G. Specification for Structural Concrete (ACI 301).
- H. Guide for Concrete Floor and Slab Construction (ACI 302.1R).
- I. Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete (ASTM C618).
- J. Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type) - (ASTM D994).
- K. Guide to Formwork for Concrete (ACI 347R).
- L. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice.
- M. Design and workmanship of all concrete shall be in accordance with referenced specifications and code listed above. Quality, tolerances, and level of performance of work shall be as specified therein. Contractor shall keep on file, in project office, current copies of all references listed above.

PART 2. PRODUCTS

2.01 FORM MATERIALS

- A. Form Material for Exposed Concrete: Plywood; 5/8" APA B-B plyform Class 1, exterior. Use plywood thickness sufficient to support concrete at temperature and rate of pour. Use only sound, undamaged sheets with clean, true edges. Furnish in largest sizes to minimize joints.
- B. Form Material for Unexposed Concrete: Plywood; 5/8" APA B-B-G-2, exposure 1, exterior, plywood graded per PS-1 standards for construction and industrial plywood. Use plywood thickness sufficient to support concrete at temperature and rate of pour. Use only sound, undamaged sheets with clean, true edges. Lumber shall be standard grade or better.

- C. In lieu of "A" above, the material specified under "B" may be used for exposed concrete if a 3/16" smooth one side, treated, pressed fiberboard liner is utilized.
- D. Lumber for light framing (less than 6" wide): standard grade and species. Framing (6" wider and from 2" to 4" thick): provide No. 1 grade in one of the following species:
 - 1. Douglas Fir (WWPA).
 - 2. Southern Pine (SPIB).
 - 3. Redwood (RIS).
- E. Prefabricated steel or metal shall be minimum 16 ga. as approved to produce surfaces equal to those specified for wood. Forms shall be matched, tight fitting, and stiffened to support weight of concrete.
- F. Metal Form Deck: Utilized to support exterior slabs; shall be S.D.I. approved and equal to Vulcraft. Spacing of slab reinforcing shall be adjusted if required to match corrugations of metal deck.
- G. Form Ties: Bolt and rod type so designed that upon removal of the form no metal shall be within 1-1/2" of the concrete surface and no holes larger than 1" in diameter. Concrete exposed to the exterior shall utilize galvanized ties.
- H. Dovetail Anchor Slots: Galvanized steel, foam filled, release tape sealed slots, bond tab anchors as manufactured by Heckmann, Hohmann & Barnard, Inc. or approved.
- I. Form Release Agent: Colorless mineral oil which will not stain the concrete or impair natural bonding characteristics of coating intended for use on concrete.
- J. Formed Construction Joints for Slab-on-Grade: Galvanized steel, tongue and groove type profile with knockout holes to receive doweling, min. 26 gage unless noted otherwise. Size and profile as indicated on drawings or as required to fit field conditions.
- K. Slab Edge Joint Filler: ASTM D994, premolded asphaltic board, thickness as indicated or (if not indicated, 1/2" thick minimum).

- L. Vapor Barrier: Conforming to ASTM E1745 Class A, non-woven, .01 permeance, not less than 15 mils thick.
 - 1. Acceptable Manufacturers:
 - a. Stego wrap 15 mil vapor barrier by Stego Industries.
 - b. WR Meadows pre-molded membrane with plasmatic core.
 - c. Zero-perm by Alumiseal.
- M. 6 mil thick, clear polyethylene film (for bond break), type recommended for below grade application.
- N. Nails, spikes, lag bolts, through bolts, anchorages: Size as required, of sufficient strength and character to maintain formwork in place while placing concrete.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Bars: ASTM A 615 Grade 60 deformed.
- B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces where lags of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.03 CONCRETE MATERIALS

- A. Cement; controlling specification for Portland Cement, ASTM C150, Type I-Normal or Type II.
- B. Aggregates shall conform to ASTM C-33. Maximum size of aggregate shall not be larger than 1/5 of narrowest dimension between forms of member for which concrete is to be used, nor larger than 3/4 of minimum clear spacing between reinforcing bars, nor larger than 1/3 of slab depth.

- C. Water: Clean and potable.
- D. Air Entrainment Admixture: ASTM C260, as manufactured by Master Builders, Euclid, or W.R. Grace.
- E. Chemical Admixtures: ASTM C494; Type 'A' - water reducing; Type 'B' - retarding, Type 'C' - accelerating, Type 'D' - water reducing and retarding, Type 'E' - water reducing and accelerating, Type 'F' - water reducing high range; Type 'G' - water reducing high range and retarding. Calcium chloride or admixtures containing more than .05 percent chloride ions by weight of admixture shall not be used. Each admixture shall not contribute more than 5 ppm by weight, of chloride ions to the total concrete constituent. Use admixtures in strict compliance with manufacturer's directions.
- F. Fly Ash: ASTM C618, Type 'C' or 'F'.
- G. Bonding Agent: Polymer resin emulsion, W.R. Grace or reviewed/approved equal.
- H. Non-Shrink Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Capable of developing a minimum compressive strength of 7000 psi at 28 days.
- I. Adhesive Anchoring: Injectable adhesive or self-contained capsule as manufactured by:
 - 1. 'Hilti' HIT System, or Architect approved/reviewed equal.

2.04 CURING COMPOUNDS & SEALERS

- A. Curing Compound/Sealer: Liquid curing compound, water base, concrete curing-sealing compound, VOC (volatile organic content) compliant, containing fugitive dye that does not leave residue (resin, varnish, wax, etc.). Fugitive dye must disappear in 7 days, as manufactured by:
 - 1. Sonneborn Building Products, Kure-N-Seal W.
 - 2. Dayton Superior Corporation, Safe Cure & Seal (J-18).
 - 3. Burke Company Spartan-Cote WB Cure Seal Hardener.
 - 4. MasterKure 100W, Master Builders, Inc.
 - 5. Vocomp-20, W.R. Meadows.

- B. Absorptive Mats: Burlap cloth, commercial quality suitable for purpose. Constructed of jute or kenaf, weighing approximately 9 oz. per square yard, complying with AASHTO M182, Class 2.
- C. Moisture retaining cover, complying with ASTM C171; one of the following: waterproof paper, polyethylene film, or polyethylene coated burlap.
- D. Crack Repair Material: Floor slabs - 2 part, 100% solid epoxy adhesive in formulation recommended by manufacturer for application, as manufactured by:
 - 1. W.R. Meadows Reziweld 1000 or Architect approved/reviewed equal.
- E. Cure/Sealer Interior Exposed Concrete Floors: Curing compound, non-residual or dissipating resin curing compound. Product of sealer manufacturer and meeting sealer manufacturer's requirements. Manufacturers to include:
 - 1. Dayton Superior Corp "Day-Chem Sill Cure" (J-13).
 - 2. L & M Cure, or Cure R.

2.05 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304 and deliver concrete in accordance with ASTM C94.
- B. Quality working stresses for the design of this project shall be based on specific minimum 28-day compressive strength of concrete or on specified minimum compressive strength at earlier age at which concrete may be expected to receive full load. Provide concrete of the following properties:
 - 1. Exterior concrete; i.e. supported slabs, exterior ramps, etc. - 3,500 psi. 28-day compressive strength; water-cement ratio, 0.40 maximum (air entrained).
 - 2. All other concrete - 3,000 psi. 28-day compressive strength; water-cement ratio, 0.45 maximum (non-air-entrained), 0.40 maximum (air entrained).
 - 3. Footings, walls and piers - 3500 psi. 28-day compressive strength; water-cement ratio, 0.45 maximum (non-air-entrained), 0.40 maximum (air entrained).

- C. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement as follows:
1. Ramps and Sloping Surfaces: Not more than 3".
 2. Reinforced Foundation Systems: Not less than 1" and not more than 4".
 3. All Other Concrete: Not less than 1" & not more than 4".
 4. Concrete containing high-range water-reducing admixture (superplasticizer). Not more than 8 inches after adding admixture to site-verified 2-3 inch slump concrete.
 5. Site added water to increase slump is strictly prohibited.
- D. Proportions of aggregate to cement shall be such as to produce a mixture which will work readily into corners, angles of forms, and around reinforcement without permitting materials to segregate. Excess free water shall not collect on concrete surface.
- E. Fly ash shall not exceed 25% of cement content by weight. No fly ash shall be used in slabs.
- F. Select admixture proportions for normal weight concrete in accordance with ACI 301, Method 1, and in strict accordance with manufacturer's instructions.
- G. Air Entraining Agent: Use in all exterior concrete exposed to weather; i.e. supported slabs, exterior ramps, etc. Air entrainment shall be accomplished by use of approved additives used in accordance with manufacturer's instructions. Limit air to 5% minimum to 7% maximum.
- H. Adjustment to concrete mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather or other circumstances warrant, as accepted by the Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

PART 3. EXECUTION

3.01 FORMWORK ERECTION

- A. Erect formwork, shoring and bracing to achieve design requirements. Fabricate forms for easy removal without hammering or prying against exposed concrete surfaces.
- B. Provide bracing to ensure stability of formwork.
- C. Apply form release agent to formwork in accordance with manufacturer's instructions, prior to placing for accessories and reinforcement.
- D. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.
- E. Clean forms as erection proceeds, to remove foreign matter.
- F. Footings and foundations shall be formed, notched and/or sleeved as indicated to provide for installation of mechanical or plumbing piping.
- G. Forms shall conform to shape, lines and dimensions of members as called for, substantially and sufficiently tight to prevent leakage of concrete.
- H. Forms shall be properly braced, and tied together so as to maintain position and shape. Forms for exposed concrete shall be braced so as to provide dimensions called for, and have taped joints.
- I. Construction joints, whether indicated on drawings or not, shall be made or located so as to least impair strength of the structure. Where joint is to be made, the surface of the concrete shall be thoroughly cleaned and all latency removed. In addition, vertical joints shall be keyed.

3.02 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

- A. Provide formed openings where required for work to be embedded in and passing through concrete members.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

- C. Install concrete accessories straight, level, and plumb.

3.03 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.
- C. Provide for continuity of reinforcing around corners in footings and walls. Lap corner bars 30 bar diameters.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.04 PLACING CONCRETE

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.
- B. Install vapor barrier under interior slab-on-grade.
 - 1. Installation shall be in accordance with manufacturers instructions and ASTM E164 3-98.
 - a. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.
 - b. Lap vapor barrier over footings and seal to foundation walls.
 - c. Overlap joints 6 inches and seal with manufacturers tape.
 - d. Seal all penetrations (including pipes) per manufacturers instruction.
 - e. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
 - f. Repair damaged areas by cutting patches of vapor barrier material overlapping the damaged area 6 inches and taping all four sides with tape.

- C. Separate exterior slabs-on-grade from vertical surfaces with $\frac{1}{2}$ inch thick joint filler, extended full thickness of slab. Also, provide filler strips at supported slabs and vertical surfaces. At interior slabs-on-grade locations, and other locations where indicated on plans, provide bond break from vertical surfaces consisting of 6 mil polyethylene film or 15# asphalt building paper.
- D. Place concrete continuously between predetermined control and construction joints. Do not break or interrupt successive pours such that cold joints occur. Where applicable, construction joints shall occur at control joint locations, unless noted otherwise.
- E. Concrete slabs on grade shall be constructed of thickness indicated. If thickness is not indicated, provide a minimum thickness of 4". Minimum thickness at pipes embedded in concrete shall not be less than three times o.d. of the pipe. All buried piping shall have been tested before placement of concrete.
- F. Pour exterior slabs on ground in sections having total area of not to exceed 1,000 sq. ft. with control joints or expansion joints arranged on approximately equal centers or as detailed. Provide interior control joints where called for on drawing as detailed. When interior construction joints occur, they shall also be considered as control joints. Provide sawed groove similar to a control joint at all construction joints.
- G. Concrete shall be conveyed from the mixer to place of final deposit by methods which will prevent separation and loss of material.
- H. All equipment used for transporting equipment shall be cleaned of all debris. Ice shall be removed from all places to be occupied by concrete forms, and masonry fillers shall be thoroughly wetted except where air temperatures are below 40°F.
- I. Equipment for chuting, pumping, pneumatically conveying concrete, shall be such size, and design as to insure practically continuous flow of concrete at delivery and without separation of materials.

- J. Concrete shall be deposited as soon as practicable in its final position to avoid segregation due to re-handling. Concreting shall be carried on at such rate that concrete is at all times plastic and flows readily into space between bars. No concrete that has partially hardened or has been contaminated by foreign materials shall be deposited on work, nor shall re-tempered concrete be used.
- K. Concreting, once started, shall be carried on as a continuous operation until placing of panel or section is completed. Top surface shall be generally level.
- L. All concrete shall be thoroughly compacted by suitable means during operation of placing and shall be thoroughly worked around reinforcement, embedded fixtures, and into corners of forms. Vibrator shall not be used to flow concrete.
- M. Place floor slabs in checkerboard or saw cut pattern indicated. Refer to structural drawings for design of construction and control joints. In all cases, spacing of control joints shall not exceed areas of 1,000 s.f.
- N. Where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrink grout or chemical adhesive. Follow manufacturer's recommendations for installation.
- O. Screed floors slabs-on-grade and concrete base for toppings level, maintaining surface flatness of maximum 1/8 inch in 10 ft.
- P. Depressed slabs: Contractor shall coordinate and verify hold-down dimensions with the trade installing items of work requiring depressed slabs; i.e. finishes and equipment, etc. Slabs shall maintain the full thickness specified or as otherwise detailed.
- Q. Provide 1/2" bituminous expansion joint filler where walks abut building walls, etc.
- R. Protecting and sealing: Protect concrete supported slabs, platforms, slabs, etc., from pedestrian traffic for three days after pouring. Concrete shall be cured using two layers of burlap kept wet for minimum of 5 days; or at Contractor's option, he may use sprayed-on compound according to manufacturer's recommendations as approved by

Architect. Curing method used shall not discolor original color of concrete, nor shall white liquid curing compound be used.

- S. Provide concrete pads, bases, foundations, etc., as indicated and/or required by mechanical, electrical, or other equipment supplier. Set anchor bolts for machine and equipment to templates or measurements provided.

3.05 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Remove formwork progressively and in accordance with code requirements.

3.06 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.
- B. Uniformly spread, screed, and float concrete.
- C. Wood float surfaces which will receive quarry tile or ceramic tile with full bed setting system.
- D. Steel trowel surfaces which will receive carpeting, resilient flooring, seamless flooring, epoxy terrazzo, or will be left exposed.
- E. Steel trowel and light broom finish surfaces which will receive thin set quarry tile or thin set ceramic tile.
- F. Maintain surface flatness, with maximum variation of 1/8 inch in 10 ft. Corridor slabs to have overall FF=40, local FF=20.
- G. In areas with a floor drain, maintain floor level at walls and pitch surfaces uniformly to drains.
- H. Floor shall be finished without excessive floating. Delay troweling until concrete is sufficiently hard to prevent water working to surface. Bring finish to smooth level surface with minimum troweling possible.

- I. Finishes, other than floors, exposed on exterior or interior shall be formed true, free from marks, irregularities. Remove any loose material, grind all projections, fill any honeycombing or holes, finish smooth. Use carborundum stone to hand rub and provide smooth, even surface where directed.
- J. Thoroughly clean and prepare concrete floors scheduled to receive a sealer. Apply in strict accordance with manufacturer's instructions.

3.07 CURING

- A. Place absorptive matting and dampen as required.
- B. Immediately after placement, protect concrete from premature drying.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- D. Provisions shall be made for maintaining concrete in moist condition for at least 5 days after placement, except high early concrete which shall be cured for at least 2 days.
- E. Cold Weather Requirements:
 - 1. General: Except as modified herein, all work shall be in accordance with ACI 306.
 - 2. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near freezing weather. No frozen materials or materials containing ice shall be used.
 - 3. All concrete materials, all reinforcement, forms, fillers, ground with which concrete is to come in contact shall be free from frost. Whenever temperature of surrounding air is below 40° F., all concrete placed in forms shall have a temperature of between 70° F., 80°F. Adequate means shall be provided for maintaining temperature of not less than 70° F. for 3 days, 50° F. for 5 days, except high-early concrete shall have temperature maintained at not less than 70° F. for 2 days, 50° F. for 3 days, or for as much more time as necessary to insure proper curing. Housing, covering, other protection used in connection with curing shall remain in place at least 24 hours after artificial

heating is discontinued. No dependence shall be placed on salt or other chemicals for prevention of freezing.

F. Weather Conditions:

1. In hot weather, sprinkle and cover all concrete for at least 24 hours longer than specified for normal curing periods.
2. In weather when temperature falls below freezing, and in any event between December 1 and April 1, no concrete shall be poured without adequate frost protection.

3.08 CONCRETE FINISHING

- A. Provide concrete surfaces to be left exposed, concrete walls, columns, etc., with smooth rubbed finish not later than one day after form removal.
 1. 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.

3.09 FIELD QUALITY CONTROL

- A. Inspection and testing shall be performed by an independent testing lab as approved by the Architect/Engineer in accordance with Division 1, Section 01450.
- B. The Contractor shall notify the Architect/Engineer and the Testing Lab at least five (5) days prior to the commencement of concrete operations.
- C. See Division 1 for inspection and testing allowances, Section 01450.
- D. Specimens shall be molded and cured as per ASTM C31. Three specimens per test, not less than one test for each day's pour, each 50 yards concrete poured, each building unit, or each strength concrete. Specimens shall be laboratory cured.
- E. Specimens shall be tested in accordance with ASTM C39. One specimen shall be tested at 7 days, two at 28 days.

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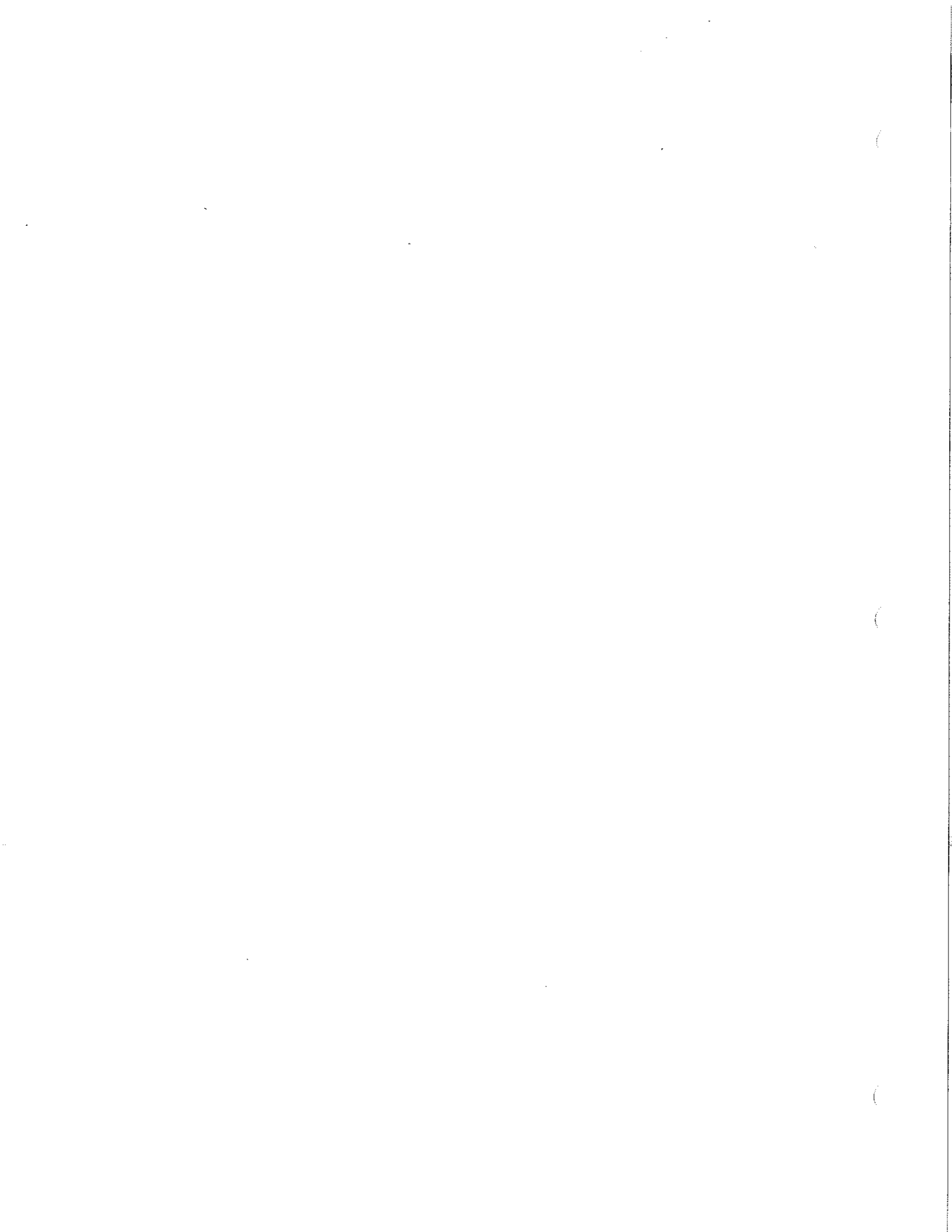
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- F. When average strength of laboratory control cylinders fall below required compressive strength, Architect shall have right to order change in proportions and water content for remainder of structure. Architect shall have right to require tests as per ACI Building Code; Chapter 20 where load tests show concrete does not conform with drawings or specifications. Deficiency shall be corrected without additional cost to Owner.
- G. Four copies of test reports at 7 days, 28 days, shall be sent directly to Architect by Testing Laboratory, with all required information shown.
- H. Slump tests per ASTM C-172 and C-143, minimum of one test for each set of cylinders, or more as conditions warrant. Deliveries exceeding specified slump shall be rejected.

3.10 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Architect/Engineer.
- B. Failure of concrete topping to bond to substrate (as evidenced by a hollow sound when tapped), or disintegration or other failure of topping to perform as a floor finish, will be considered failure of materials and workmanship. Repair or replace toppings in areas of such failures, as directed.

END OF SECTION 03001



SECTION 05120 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes structural steel and grout

1.02 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.03 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use ASD; data are given at service-load level.

- B. Moment Connections: Type FR, fully restrained.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or have an equivalent quality assurance program as certified by a qualified independent testing agency.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE, or have an equivalent quality assurance program as certified by a qualified independent testing agency.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992/A 992M.
- C. Channels, Angles, Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts[or tension-control, bolt-nut-washer assemblies with splined ends]; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 1. Finish: Hot-dip zinc coating] [Mechanically deposited zinc coating] [Hot-dip or mechanically deposited zinc coating].
 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with [mechanically deposited zinc coating] [mechanically deposited zinc coating, baked epoxy-coated] finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, [heavy-hex] [round] head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: [Plain] [Mechanically deposited zinc coating].
- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- F. Unheaded Anchor Rods: ASTM F 1554, Grade 36, or ASTM F 1554, Grade 55, weldable (refer to Structural Steel Notes on drawings for additional information).
 1. Configuration: Straight.
 2. Finish: Plain.
- G. Headed Anchor Rods: ASTM F 1554, Grade 36 or ASTM F 1554, Grade 55, weldable, straight (refer to Structural Steel Notes on drawings for additional information).
 1. Finish: Plain.

H. Threaded Rods: ASTM A 36/A 36M.

1. Finish: Plain, or hot-dip zinc coating
ASTM A 153/A 153M, Class C, if exposed to weather.

2.03 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."] [Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]
- C. Primer: SSPC-Paint 25, [Type I] [Type II], zinc oxide, alkyd, linseed oil primer.
- D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.04 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

- B. 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/D1.1M and manufacturer's written instructions.

2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

- 1. Joint Type: Snug tightened, unless noted otherwise.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.07 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 (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

- 1. SSPC-SP 3, "Power Tool Cleaning."
 - 2. SSPC-SP6, "Commercial Blast Cleaning" for galvanized surfaces.

- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
- B. Galvanize above the roof and outside the building envelope (exposed to weather).

2.09 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency (Special Inspector, refer to Structural drawings for additional information) to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, 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. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base, Bearing, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.03 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, unless noted otherwise.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency (Special Inspector, refer to Structural drawings for additional information) to inspect field welds, and, high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be [tested and] inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. 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.

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- c. Ultrasonic Inspection: ASTM E 164.
- d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 05120

SECTION 05500 - METAL FABRICATIONS

PART 1. GENERAL

1.01 RELATED DOCUMENTS

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

- A. Work included in this section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of miscellaneous metal work shown on the drawings, as specified herein, and/or as needed for a complete and proper installation whether shown or not.
- B. Related work specified elsewhere:
 - 1. Section 05120 - "Structural Steel", including all angles, beams, columns, bolts, etc., shown on the structural drawings or required by the architectural drawings.

1.03 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.
- C. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the work.
- D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel," AWS D1.2 "Structural Welding Code-Aluminum," and AWS D1.3 "Structural Welding Code-Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.04 SUBMITTALS

- A. Comply with pertinent provisions of Division 1.
- B. Product Data: Within 35 calendar days after the contractor has received the Construction Manager's Notice to Proceed, submit:
 1. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this section with the work of adjacent trades. Provide templates for anchors and bolts specified for installation under other sections.
 2. Submit signed and sealed calculations for steel pipe railings by the registered professional engineer registered in the State of Michigan responsible for their preparation.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Check Actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 1. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2. PRODUCTS

2.01 MATERIALS

- A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with following standards as pertinent:

1. Steel plates, shapes and bars: ASTM A36.
2. Steel plates to be bent or cold-formed: ASTM A283, Grade C.
3. Steel tubing: ASTM A501, Grade B.
4. Cold-finished steel bars: ASTM A108.
5. Cold-rolled carbon steel sheets: ASTM A336.
6. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525.
7. Steel pipe: ASTM A53, Grade B, standard weight, black finish unless otherwise noted.
8. For exterior installations and where indicated, provide members with hot-dip galvanizing coat per ASTM A53.
9. Concrete inserts:
 - a. Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27.
 - b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

2.02 FASTENERS

A. General:

1. For exterior use and where built into exterior walls, provide zinc-coated fasteners.
2. Provide fasteners of type, grade, and class required for the particular use.

B. Comply with following standards as pertinent:

1. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, Grade A.
2. Lag bolts: Provide square-head type complying with Fed. Spec. FF-B-561.
3. Machine screws: Provide cadmium plated steel type complying with Fed. Spec. FF-S-111.
4. Washers:
 - a. Plain washers: Comply with Fed. Spec. FF-W-92, round, carbon steel.
 - b. Lock washers: Comply with Fed. Spec. FF-W-84, helical spring type carbon steel.
5. Toggle bolts: Provide type, class and style needed but complying with Fed. Spec. FF-B-588.
6. Anchorage devices: Provide expansion shield complying with Fed. Spec. FF-S-325.

2.03 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by contractor subject to the approval of the Architect.

2.04 SHOP PAINT

- A. Primer: Use "10-99 Tnemec Primer" or Architect/Engineer equal product by Rustoleum.
- B. For repair of galvanizing, use a high zinc-dust content paint complying with SSPC-paint 20. Dry film containing not less than 94 percent zinc dust by weight.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.05 FABRICATION

- A. Except as otherwise shown on the drawings or the approved shop drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.
- B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.
- C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the items.
- D. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.
- E. Shear and punch metals cleanly and accurately. Remove burrs.
- F. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- G. Shop Assembly: Preassemble 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 reassembly and coordinated installation.

2.06 MISCELLANEOUS METAL FABRICATIONS

A. Rough Hardware:

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Section 06100.
2. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Loose Bearing and Leveling Plates:

1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

C. Loose Steel Lintels:

1. Provide loose structural steel lintels for opening and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8" bearing at each side of openings, unless otherwise shown.
2. Size lintels as follows, unless otherwise indicated.
 - a. Up to 4'-0" span: One 3 1/2" x 4" x 5/16" steel angle supporting each 4" thick module of masonry.
 - b. Spans 4'-0" to 7'-0": One 5" x 3-1/2" x 5/16" steel angle supporting each 4" thick module of masonry.
 - c. Over 7'-0": Consult Architect if not indicated.

3. Hot dip galvanized loose steel lintels to be installed in exterior walls.

D. Steel Pipe Railings:

1. Provide railings and handrails capable of withstanding the following loads applied as indicated when tested per ASTM E 935.
 - a. Concentrated loads of 200 lbs. Applied at any point in any direction.
 - b. Uniform load of 50 lbs. Per linear ft. applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - d. Infill of Guards:
Concentrated load of 50 lbs. applied horizontally on an area 1 sq. ft.
Uniform load of 25 lb./ft. applied horizontally.
Infill load and other loads need not be assumed to act concurrently.
 - e. Provide X-Strong pipe (Schedule 80).
2. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option.
3. At tee and cross intersections provide coped joints.
4. At bends interconnect pipe by means of prefabricated elbow fittings or flush radius bends, as applicable.
5. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.
6. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.
7. Close exposed ends of pipe by welding 3/16" thick steel plate in place or by use of prefabricated fittings.
8. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

E. Miscellaneous Framing and Supports:

1. Provide miscellaneous steel framing and supports as required to complete work.
2. Fabricate miscellaneous units to sizes, shapes, and profiles shown or, if not shown, or required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes, plates, and steel bars of welded construction using metered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
3. Hot dip galvanize exterior miscellaneous frames and supports.

PART 3. EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.03 INSTALLATION

A. General:

1. Set work accurately into position, plumb, level, true and free from rack.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc welding for appearance and quality of weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth and touch up shop prime coats.
5. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.

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- B. Immediately after erection, clean the field welds, bolted connections and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.

END OF SECTION 05500

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SECTION 06100 - CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of the carpentry work is shown on the Drawings.

1.03 QUALITY ASSURANCE:

- A. Lumber Standard: Comply with U.S. Department of Commerce Product Voluntary Standards PS 1-07, "Structural Plywood", PS 2-04 Performance Standard for "Wood based structural use panels" and PS 20-05 American Softwood Lumber Standard, except as otherwise indicated.
- B. Factory mark each piece of lumber and plywood with type, grade, mill, and grading agency: West Coast Lumber Assoc. (WBLC) or Western Wood Products Association (WWPA).

1.04 SUBMITTALS:

- A. Wood Treatment Data:
 - 1. Submit treatment manufacturer's instructions for proper use of each type of treated material.
 - a. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained, and conformance with applicable standards.
 - b. For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to project site.

- B. Product Data:

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1. Submit manufacturer's specifications and other data for each carpentry anchorage, fastening, and miscellaneous material. Provide material certificates for all lumber and plywood. Transmit a copy of each instruction to the Installer.

1.05 PRODUCT HANDLING:

- A. Delivery and Storage: Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood and provide air circulation within stacks.

1.06 JOB CONDITIONS:

- A. Coordination: Fit carpentry work to other work, scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Lumber - General:

1. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20-05, for the moisture content specified for each use. Use dressed lumber, surfaced four sides (SFS) seasoned with 19% maximum moisture content at time of dressing.

B. Framing Lumber (2" through 4" thick):

1. For light framing (less than 6" wide), provide Construction Grade Douglas Fir as graded by the West Coast Lumber Bureau (WCLB) or equivalent species and grade with minimum fiber stress rating (bending) of 1000 psi (Fb), and modulus of elasticity of 1,500,000 psi.
2. For structural framing (6" and wider and from 2" to 4" thick) provide dense No. 1 Grade Douglas Fir as graded by the West Coast Lumber Bureau (WCLB) or equivalent species and grade with minimum fiber stress rating (bending) of 1500 psi (Fb), and modulus of elasticity of 1,700,000 psi.

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C. Boards (less than 2" thick):

1. Produce lumber of 19% maximum moisture content (S-DRY) and of the following species and grade.
 - a. Redwood Construction Common (RIS).
 - b. Southern Pine No. 2 Boards (SPIB).
 - c. Or any species graded construction Boards (WCLB or WWPB).

D. Plywood:

1. Provide only Douglas Fir Plywood in accordance with grading requirements of the APA - The Engineered Wood Association as follows:
 - a. Treated non-combustible AC standard with exterior glue.

E. Anchorage and fastening Materials:

1. Select proper type, size, material, and finish for each application. Comply with the following:
 - a. Nails and Staples: FS FF-N-105.
 - b. Wood Screws: FS FF-S-111.
 - c. Bolts and Studs: FS FF-B-575.
 - d. Nuts: FS FF-N-836.
 - e. Washers: FS FF-W-92.
 - f. Lag Screws or Lag Bolts: FS FF-B-561.
 - g. Masonry Anchoring Devices: For expansion shields, nails, and drive screws, comply with FS FF-S-325.
 - h. Toggle Bolts: FS FF-B-588.
 - i. Bar or Strap Anchors: ASTM A 575 carbon steel bars.

2.02 WOOD TREATMENT:

- A. Preservation Treatment: Where lumber or plywood is indicated as "Treated" or is specified herein to be treated, comply with the applicable requirements of the American Wood Preservers Association (AWPA) AWPA P23-08, ASTM D-1625 and Federal Specification TT-W-50.

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- B. Pressure-treat above-ground items with water-borne preservatives complying with AWWA P5-09, ASTM D-1760, and Federal Specification TT-W-571. After treatment, kiln-dry to a maximum moisture content of 19%. Treat indicated items and the following, except where fire retardant treated.
 - 1. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 12 inches above grade excepting timber.
- C. Fire Retardant Treated:
 - 1. Wood blocking and similar items installed within the building shall be pressure impregnation with retardant chemicals to achieve a flame spread rating of not more than 25 when tested in accordance with UL Test 723, ASTM E 84, or NFPA Test 355.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed and notify the Constructor, in writing, of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 INSTALLATION:

A. General:

- 1. Discard units of material with defects which might impair the quality of the work, and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.
- 2. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

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3. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required. Provide washers under bolt heads and nuts in contact with wood. Nail plywood in accordance with the recommendations of APA-The Engineered Wood Association.
4. Use common wire nails, except as otherwise shown or specified herein. Use finishing nails for exposed work. Do not wax or lubricate fasteners that depend on friction for holding power. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required. Do not drive threaded friction type fasteners; turn into place. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.

B. Wood Grounds, Nailers, Blocking and Sleepers:

1. Provide wherever shown and where required for screening or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to form work before concrete placement.
3. Provide permanent grounds of dressed, pressure preservative treated key-bevelled lumber not less than 1-1/2" wide and of the thickness required to bring face of ground to exact thickness of finished material involved. Remove temporary grounds when no longer required.

C. Wood Furring:

1. Install plumb and level with closure strips at all edges and openings. Shim with wood as required for tolerance of finished work.

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D. Wood Framing:

1. Provide framing members of sizes and on spacings shown and frame openings as shown, or if not shown, comply with recommendations of "The Wood Frame Construction Manual" 2001 Ed. of the American Wood Council. Do not splice structural members between supports.
2. Anchor and nail as shown, and comply with the "Recommended Nailing Schedule - Table I of the Manual for Housing Framing: and other recommendations of the N.F.P.A.

E. Installation of Plywood:

1. Comply with recommendations of the Engineered Wood Association (APA) for the installation of plywood.

END OF SECTION 06100

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SECTION 07910 - JOINT FILLERS AND GASKETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of each type of joint filler and gasket work is indicated on the drawings and by provisions of this section, and is hereby defined to include required fillers and gaskets not specified in other sections of these specifications.
- B. The required applications of joint fillers and gaskets include, but are not necessarily limited to, the following general types and locations:
 - 1. Pavement, curb and sidewalk joint fillers.
 - 2. Isolation and expansion joint fillers in structural concrete.
 - 3. Exterior wall component joint fillers.
 - 4. Floor construction/expansion joint fillers.
 - 5. Joint fillers around penetrations of equipment and services through walls, floors and roofs.

1.03 SUBMITTALS:

A. Product Data:

- 1. Submit manufacturer's specifications, installation instructions and recommendations for each type of material required.

B. Samples:

- 1. Submit three, 12 inches long samples of each joint filler or gasket.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Size and Shape: Provide sizes and shapes of units as shown or, if not shown, as recommended by manufacturer for joint size and condition shown. Where joint movement is a factor in a determination of size, consult with Architect to determine nature and magnitude of anticipated joint movements for the temperature and condition of project at time of installation.
- B. Compressibility: Specified hardness and compressibilities are intended to establish requirements for normal or average conditions of installation and use. Where a range of hardness or compressibility is available for a product, comply with manufacturer's recommendations for specific condition of use.
- C. Color: Provide each concealed material in manufacturer's standard color which has best overall performance characteristics for application shown. Provide exposed materials in black, except where another color is indicated.
- D. Compatibility: Before purchase of each filler or gasket material, confirm that it is compatible with substrate, sealants and other materials in joint system.
- E. Adhesives: Pressure sensitive adhesives, compatible with each material in joint system may be applied (at installer's option) to one face of joint fillers and gaskets to facilitate installation and permanent anchorage. Do not allow adhesives to contaminate sealant bond surface (if any) in joint system.

2.02 CONCRETE CONTROL/EXPANSION JOINT FILLERS:

A. Bituminous and Fiber Joint Filler:

- 1. Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D 1751, FS HH-F-341, Type 1 and AASHO M 213.

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2. Provide one of the following products:
 - a. Flexcell-Knight-Celotex Corporation
 - b. Expansion-Joint Filler; BASF/Sonneborn
 - c. FF-14. Asphalt Fiber-Board; Progress Unlimited
 - d. Fibre Expansion Joint; W.R. Meadows, Inc.
 - e. Conflex Fiber Expansion Control Joint Filler, JD Russell

2.03 CELLULAR/FOAM EXPANSION JOINT FILLERS:

A. Closed-Cell PVC Joint Filler:

1. Provide flexible expanded polyvinyl chloride complying with ASTM D 1667. Grade VE 41 BL (3.0 psi compression deflection); except provide higher compression deflection grades as may be necessary to withstand installation forces.
2. Provide one of the following products:
 - a. FF2 PVC: Progress Unlimited, Inc.
 - b. Vinyl "U" 1000 Series: Williams Products, Inc.

2.04 GASKETS:

A. Molded Neoprene Gasket:

1. Provide extruded neoprene or EPDM gaskets complying with ASTM D 2000, Designation 2BC 415 to 3BC 620, black (40 to 60 Shore A durometer hardness); of the profile shown or, if not shown, as required by the joint shape, size and movement characteristics to maintain a watertight and airtight seal.
2. Provide products by one of the following manufacturers:
 - a. D.S. Brown Company
 - b. Hohmann & Barnard, Inc.
 - c. Kirkhill Rubber Company
 - d. Progress Unlimited, Inc.
 - e. JD Russell
 - f. Williams Products, Inc.

2.05 MISCELLANEOUS MATERIALS:

A. Oakum Joint Filler:

1. Provide untreated hemp or jute fiber rope, free of oil, tar and other compounds which might stain surfaces, contaminate joint walls or not be compatible with sealants.

B. Fire-Resistant Joint Filler:

1. Glass fiber or other inorganic non-combustible fiber formed with minimum of binder into resilient joint filler strips or blankets of sizes and shapes indicated, recommended by manufacturer specifically for increasing fire resistance or endurance of joint systems of type indicated, for service temperatures up to 2300 degrees F, 80% (min.) recovery 50% compression.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine joint surfaces of units to receive fillers or gaskets and conditions under which the work is to be performed and notify the Construction Manager, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION:

- A. Comply with manufacturer's instructions and recommendations for installation of each type of joint filler or gasket required, unless more stringent requirements are shown or specified.
- B. Set units at proper depth of position in joint to coordinate with other work, including installation of bond breakers, backer rods, and sealants. Do not leave voids or gaps between ends of joint filler units.

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- C. Recess exposed edges or faces of gaskets and exposed joint filler slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

- D. Bond ends of gaskets together with adhesive or by means as recommended by manufacturer to ensure continuous watertight and airtight performance. Miter-cut and bond ends at corners except where molded corner units are provided.

END OF SECTION 07910



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SECTION 07920 - SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of each type of sealant and caulking work is indicated on the drawings, and by provisions of this section.
- B. The required applications of sealants and caulking include, but are not necessarily limited to, the following general locations:
 - 1. Flashing reglets and retainers.
 - 2. Exterior wall joints.
 - 3. Masonry control joints, exterior and interior.
 - 4. Interior sound-sealed and air-sealed joints.
 - 5. Flooring joints.
 - 6. Isolation joints, between structure and other elements.
 - 7. Paving and sidewalk joints.
 - 8. Joints at penetrations of walls, decks and floors by piping and other services and equipment.
 - 9. Joints between items of equipment and other construction.
 - 10. Joints between dissimilar materials.

1.03 QUALITY ASSURANCE:

- A. Manufacturers: Firms with not less than 5 years of successful experience in production of types of sealants and caulking compounds required for this project.
 - 1. Obtain elastomeric sealants from a manufacturer which will, upon request, send a qualified technical representative to the project site for purpose of advising installer on proper procedures for use of products.
- B. Installer: A firm with a minimum of 5 years of successful experience in application of types of materials required.

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1.04 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's specifications, recommendations and installation and instructions for each type of sealant, caulking compound and associated miscellaneous material required.

B. Samples:

1. Submit three, 12" long samples of each color required (except black) for each type of sealant and caulking compound exposed to view. Install sample between two strips of material similar to or representative of typical surfaces where compound will be used, held apart to represent typical joint widths.

1.05 JOB CONDITIONS:

- A. Pre-Installation Meeting: At Construction Manager's direction, installer, sealant manufacturer's technical representative, and other trades involved in coordination with sealant work shall meet with Construction Manager at project site to review procedures and time schedule proposed for installation of sealants in coordination with other work. Review each major sealant application required on project.
- B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended temperature range for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of the manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures. Coordinate time schedule with Construction Manager to avoid delay of project.

- C. Statement of Non-Compliance: Where it is necessary to proceed with installation of sealants or caulking compound under conditions which do not fully comply with requirements (because of time schedule or other reasons which the Construction Manager determines to be crucial to project), prepare written statement for Owner's record (with copy to Architect) indicating the nature of non-compliance, reasons for proceeding, precautionary measures taken to ensure best possible work, and names of individuals concurring with decision to proceed with installation.

1.06 SPECIAL PROJECT WARRANTY (GUARANTEE):

- A. Sealant Warranty: Provide written warranty, signed by contractor and installer, agreeing to, within warranty period of 10 years after date of substantial completion, replace/repair defective materials and workmanship defined to include: Instances of significant leakage of water or air; failures in joint adhesion, material cohesion, abrasion resistance, strain resistance or general durability; failure to perform as required, and the general appearance of deterioration in any other manner not clearly specified in manufacturer's published product literature as an inherent characteristic of the sealant material. Warranty includes responsibility for removal and replacement of other work (if any) which conceals or obstructs the replacement of sealants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Colors: Provide black or other natural color where no other standard or custom color is available. Where material is not exposed to view, provide manufacturer's standard color which has best overall performance characteristics for application shown.
1. Provide manufacturer's standard colors as selected by Architect from manufacturer's standard colors.

- B. Hardnesses shown and specified are intended to indicate general range necessary for overall performance. Consult manufacturer's technical representative to determine actual hardness recommended for conditions of installation and use. Upon request, Architect will furnish information concerning anticipated joint movement related to actual joint width and installation temperature. Except as otherwise indicated or recommended, provide compounds within the following range of hardness (Shore A, fully cured, at 75 degrees F.).
1. 5 to 20 for high percentage of movement and minimum exposure to weather and abrasion (including no exposure to vandalism).
 2. 15 to 35 for moderate percentage of movement and moderate exposure to weather and abrasion.
 3. 30 to 60 for low percentage of movement and maximum exposure to weather and abrasion (including foot traffic on horizontal joints).
- C. Modulus of Elasticity: For joints subjected to movement, either thermal expansion or dynamic movement, select sealants from among available variations which have lowest modulus of elasticity which is consistent with exposure to abrasion or vandalism. For horizontal joints subject to traffic, select sealants with high modulus of elasticity as required to withstand indentation by stiletto heels. Comply with manufacturer's recommendations where no other requirements are indicated.
- D. Compatibility: Before selection and purchase of each specified sealant, investigate its compatibility with joint surfaces, joint fillers and other materials in joint system. Provide only materials (manufacturer's recommended variation of specified materials) which are known to be fully compatible with actual installation conditions as shown by manufacturer's published data or certification.

2.02 SEALANTS:

- A. One Part Elastomeric Sealant (Silicone)
 - 1. One component elastomeric sealant, complying with ASTM C 920, Class 25, Type NS (nonsag), unless Type S (self-leveling) recommended by manufacturer for the application shown.
 - a. Acceptable Standard
 - 1. "Pecora 864 Architectural Silicone Sealant; Pecora Corp.
 - 2. Dow Corning 791; Dow Corning Corp.
 - 3. Silpruf; General Electric
 - 4. Omniseal; Sonneborn Building Products, Inc.
 - 5. Spectrem 2; Tremco Mfg. Co.
 - 2. One-Component mildew resistant silicone sealant: (Around countertops and backsplashes and other wet interior locations).
 - a. Acceptable Standard
 - 1. Rhodorsil 6B white; Rhone-Poulenc Inc.
 - 2. Dow Corning 786; Dow Corning Corp.
 - 3. Sanitary 1700; General Electric
 - 3. One Component high movement joints (+100/-50): Where locations of high movement are indicated.
 - a. Dow Corning 790; Dow Corning Corp.,
 - b. Spectrem 1; Tremco
- B. Elastomeric Sealant (Polyurethane)
 - 1. One component polyurethane sealant, complying with ASTM C 920, Type S, Grade NS, Class 25 (nonsag).
 - a. Acceptable Standard
 - 1. Sonolastic NP 1; Sonneborn Building Products Inc.
 - 2. Dymonic; Tremco Mfg. Co.
 - 3. Dynatrol I; Pecora Corp.
 - 4. Vulkem 921; Mameco
 - 5. CS 2130; Hilti
 - 6. Sikaflex 1A; Sika Corp.
 - 7. Sikaflex 15LM; Sika Corp.

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2. Two Component polyurethane sealant, complying with ASTM C 920, Type M, Grade NS, Class 25 (nonsag).
 - a. Acceptable Standard
 1. Sonolastic NP 2; Sonneborn Building Products Inc.
 2. Dymeric; Tremco Mfg. Co.
 3. Dynatrol II; Pecora Corp.
 4. Vulkem 922; Mameco
 5. Sikaflex LCNSEZ; Sika Corp.
- C. One-part self-leveling polyurethane sealant (for traffic areas).
 1. One Component polyurethane self-leveling sealant, complying with ASTM C 920, Type S, Grade P, Class 25.
 - a. Acceptable Standard
 1. Sonolastic SL 1; Sonneborn Building Products Inc.
 2. NR-201 Urexpan; Pecora Corp.
 3. Vulkem 45; Mameco
 4. Sikaflex 1CSL; Sika Corp.
 2. Two-component polyurethane self-leveling sealant, complying with ASTM C 920, Type M, Grade P, Class 25.
 - a. Acceptable Standard
 1. Sonolastic SL 2; Sonneborn Building Products Inc.
 2. NR-200 Urexpan; Pecora Corp.
 3. Vulkem 245; Mameco
 4. THC900/THC901; Tremco
 5. Sikaflex
- D. Security Sealant (Polyurethane)
 1. One component or two component polyurethane sealant, complying with ASTM C 920, Grade NS, Class 12.5, with a Shore A Hardness of 55.
 - a. Acceptable Standard
 1. Dynaflex; Pecora Corp.
 2. Ultra; Sonneborn Building Products, Inc.

2.04 CAULKING COMPOUNDS:

- A. Caulking Compounds: (Acrylic Latex Sealant)
 - 1. Latex rubber modified, acrylic emulsion polymer sealant compound; manufacturer's standard, one part, nonsag, mildew resistant, acrylic emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent.
 - 2. Acceptable Standard
 - a. Sonolac, Sonneborn Building Products Inc.
 - b. Acrylic Latex Caulk 834, Tremco Inc.
 - c. Acrylic Latex Caulk with Silicone, DAP
 - d. AC-20, Pecora Corp.

2.05 MISCELLANEOUS MATERIALS:

- A. Joint Cleaner: Provide type of joint cleaning compound recommended by sealant or caulking compound manufacturer, for joint surfaces to be cleaned.
- B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer, for joint surfaces to be primed or sealed.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.
- D. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer.
- E. Provide size and shape of rod which will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. The installer must examine joint surfaces, backing and anchorage of units forming sealant rabbet and condition under which sealant work is to be performed and notify the Construction Manager in writing of conditions detrimental to proper completion of the work and performance by sealants. Do not proceed with sealant work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 SELECTION OF MATERIAL

- A. Caulking compounds shall be used for interior nonmoving joints and at locations indicated.
- B. One component elastomeric silicone sealants shall be used at exterior and interior joints where thermal or dynamic movement is anticipated including, but not limited to, the following locations:
 - 1. Metal to metal joints.
 - 2. Sheet metal flashing, coping, preformed metal caps, fascias, extenders, trim, and panels.
- C. One or two component elastomeric polyurethane sealants shall be used at exterior and interior joints where weatherproofing or waterproofing is required and at exterior joints between dissimilar materials including, but not limited to, the following locations:
 - 1. Expansion and control joints.
 - 2. Exterior side of hollow metal frames to adjacent materials.
 - 3. Exterior side of aluminum frames to adjacent dissimilar materials.
 - 4. Lintels and shelf angles to masonry construction.
 - 5. Louvers to adjacent construction.
 - 6. Vertical interior expansion joints and horizontal interior and exterior control joints and expansion joints in the building.
 - 7. Joints in concrete site improvements (sidewalks, ramps, retaining walls) and the joint between the concrete slabs and dissimilar materials.
 - 8. Sealant in pipe sleeves where materials must perforate the floor slab.
 - 9. Perimeter of floor slabs or concrete curbs which abut vertical surfaces.

10. Exterior joints between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components as may be dictated by the various methods of construction to make watertight.
 11. Exterior locations which are noted "caulked" or "sealant" and not specifically listed herein or included in the work of other sections of the Specifications.
 12. Interior joints between dissimilar materials where the joining of the 2 surfaces leave a gap between the meeting materials and components.
 13. Exterior insulation and finish system:
 - a. Joints, including actual and false joints in system, at openings and penetrations in the system, and joints where the wall system abuts other materials.
- D. One or two part self-leveling polyurethane sealants shall be used for exterior and interior horizontal joints subject primarily to pedestrian traffic and light and moderate vehicular traffic.
- E. Security sealant shall be used in vertical control joints in the interior side of building.

3.03 JOINT SURFACE PREPARATION:

- A. Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or caulking compound.
- B. For elastomeric sealants, do not proceed with installation of sealant over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with paragraph 4.3.9. of FS TT-S-00227 has successfully demonstrated that sealant bond is not impaired by coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

- C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5% solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.
- D. Roughen joint surfaces on vitreous coated and similar non-porous materials, where sealant manufacturer's data indicated lower bond strength than for porous surfaces. Rub with fine abrasive to produce a dull sheen.

3.04 INSTALLATION:

- A. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.
- B. Prime or seal joint surfaces where shown or recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- C. Install sealant backer rod for liquid sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.
- D. Install bond breaker tape where shown and where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.
- E. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- F. Install sealants to depths as shown or if not shown as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead.

1. For sidewalks, pavement and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width and neither more than 5/8" deep nor less than 3/8" deep.
 2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.
 3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75% to 125% of joint width.
- G. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces including exposed aggregate panels and similar rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces but either primer/sealer or the sealant/caulking compound.
- H. Remove excess and spillage of compounds promptly as the work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage without damage to adjoining surfaces or finishes.
- I. Polysulfide Sealant Installation: Comply with standards issued by Thiokol Chemical Corp., except where more stringent requirements have been shown or specified, or have been issued by sealant manufacturer as either requirements or recommendations.

3.04 CURE AND PROTECTION:

- A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability. Do not cure in a manner which would significantly alter materials modulus of elasticity or other characteristics.

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- B. Installer shall advise the Construction Manager of procedures required for curing and protection of sealants and caulking compounds during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of Owner's acceptance.

END OF SECTION 07920

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SECTION 08112 - HOLLOW METAL WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of hollow metal work is shown on the drawings and schedules.
- B. This section includes hollow metal doors and pressed steel frames for doors and related openings.
- C. Related Work Specified Elsewhere:
 - 1. Fire Rated Glass: Section 08810

1.03 QUALITY ASSURANCE:

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.
- B. Fire-rated door assemblies shall be Underwriter Laboratory.: 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", and have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests for Door Assemblies". All metal labels to be riveted to door and frames mylar labels not acceptable.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.
- B. Shop Drawings: Submit shop drawings for the fabrication and installation of hollow metal work. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.

1. Provide a schedule of doors and frames using same reference numbers for details and openings as those on the contract drawings.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.
- B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Architect; otherwise remove and replace damaged items as directed.
- C. Store doors and frames at the building site under cover. Place units on at least 4" high wood sills or on floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. If the cardboard wrappers on doors become wet, remove carton immediately. Provide 1/4" spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Hot-Rolled Steel Sheets and Strips: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM 568.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.
- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G90 zinc coating, mill phosphatized.
- D. Supports and Anchors: Fabricate of not less than 16 gage sheet metal. Galvanize after fabrication units to be built into exterior walls, complying with ASTM A 153, Class B.
- E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

- F. Shop-Applied Paint: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as base for specified finish paints on steel surfaces.

2.02 FABRICATION, GENERAL:

- A. Fabricate hollow metal units to be rigid, neat in appearance, and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment to assure proper assembly at the project site. Weld exposed joints continuously; grind, dress, and make smooth, flush, and invisible. Metallic filler to conceal manufacturing defects is not acceptable.
- B. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.
- C. Finish Hardware Preparation:
 - 1. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.
 - 2. Reinforce hollow metal units to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
 - 3. Locate finish hardware as shown on final shop drawings, or if not shown, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.
- D. Shop Painting:
 - 1. Clean, treat and paint exposed surfaces of fabricated hollow metal units, including galvanized surfaces.
 - 2. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.

3. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT-2), hot phosphate solution (SSPC-PT4) or basic zinc chromate-vinyl butyral solution (SSPC-PT3).
 4. Apply shop coat or prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 2.0 mils.
- E. Manufacturer: Provide hollow metal work by one of the following:
1. Ceco Door Products
 2. Curries
 3. Steelcraft/Div of Ingersol Rand
- 2.03 DOORS:
- A. General:
1. Provide flush design doors, 1-3/4" thick, seamless hollow construction, unless otherwise indicated. Bevel both vertical edges 1/8" in 2".
 2. Insulated doors: Interior core of doors to be foamed in place, closed cell, polyurethane foam chemically bonded to door face sheets. Voids in foam will not exceed 1/2" in any direction. Compressive strength of polyurethane to be minimum of 20 PSI. Foam density not less than 1-8 PCF. Polystyrene core doors not acceptable. Doors to have R factor of not less than 14.81 U factor of .068.
- B. Exterior Doors:
1. Fabricate exterior doors of 2 outer, galvanized, stretcher-level steel sheets not less than 16 gage. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges except around glazed or louvered panel inserts. Provide weephole openings in the bottom of doors to permit escape of entrapped moisture.
 2. Reinforce inside of doors with vertical galvanized sheet steel sections not less than 22 gage. Space vertical reinforcing 6" o.c. and extend full door height. Spot-weld at not more than 5" o.c. to both face sheets.

- a. Continuous truss-form inner core of 28 gage galvanized sheet steel reinforcing may be provided as inner reinforcement in lieu of above. Spot-weld truss-form reinforcement 3" o.c. vertically and horizontally over entire surface of both sides.
 3. Reinforce tops and bottoms of doors with 16 gage horizontal steel channels welded continuously to outer sheets. Close top and bottom edges to provide weather seal as integral part of door construction or by addition or inverted steel channels.
- C. Interior Doors:
1. Fabricate interior doors of two outer, cold-rolled, stretcher-leveled steel sheets not less than 16 gage. Construct doors with smooth, flush surfaces, without visible joints or seams on exposed faces or stile edges except around glazed or louvered panel inserts.
 2. Reinforce inside of doors with vertical, hot-rolled, not less than 22 gage steel sections. Space vertical reinforcing 6" o.c. and extend full door height. Spot weld at not more than 5" o.c. to both face sheets.
 - a. Continuous truss-form inner core of 28 gage sheet metal reinforcing may be provided as inner reinforcement in lieu of above. Spot-weld truss-form reinforcement 3" o.c. vertically and horizontally over entire surface of both sides.
 3. Reinforce tops and bottoms of doors with 16 gage, horizontal steel channels, welded continuously to outer sheets.
- D. Finish Hardware Reinforcement: Reinforce doors for required finish hardware as follows:
1. Hinges: Steel plate 3/16" thick x 1-1/2" wide x 6" longer than hinge, secured by not less than 6 spot-welds.
 2. Mortise Locksets and Dead Bolts: 14 gage steel sheet, secured with not less than two spot-welds.
 3. Cylinder Locks: 12 gage steel sheet, secured with not less than two spot-welds.

4. Flush Bolts: 12 gage steel sheet, secured with not less than two spot-welds.
5. Surface-Applied Closers: 12 gage steel sheet, secured with not less than six spot-welds.
6. Flush Plates and Bars: 16 gage steel sheet (except when through bolts are shown or specified), secured with not less than two spot-welds.
7. Surface Panic Devices: 14 gage sheet steel (except when through bolts are shown or specified), secured with not less than two spot-welds.

2.04 FRAMES:

- A. Provide hollow metal frames for doors, side-lights, borrowed lights, and other openings of sizes and profiles as indicated.
- B. Fabricate frames of full-welded unit construction with corners mitered, reinforced, continuously welded full depth and width of frame, unless otherwise indicated.
 1. Knock-down type frames are not acceptable.
- C. Form frames of galvanized steel sheets for exterior and either cold or hot-rolled sheet steel for interior.
 1. Gage: Not less than 14, for exterior openings up to and including 4'-0" wide.
 2. Gage: Not less than 14, for interior openings up to and including 4'-0" wide.
 3. For openings over 4'-0" wide, increase thickness by at least two standard gages.
- D. Finish Hardware Reinforcement: Reinforce frames for required finish hardware as follows:
 1. Hinges and Pivots: Steel plate 3/16" thick x 1-1/2" wide x 6" longer than hinge, secured by not less than six spot-welds.
 2. Strike Plate Clips: Steel plate 3/16" thick x 1-1/2" wide x 3" long.
 3. Surface-Applied Closers: 12 gage steel sheet, secured with not less than six spot-welds.

4. Concealed Closers: Removable steel access plate, 12 gage internal reinforcement of size and shape required, and enclosing housing to keep closer pocket free of mortar or other materials.
- E. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at top for grouting.
- F. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18 gage galvanized steel.
 1. Masonry Construction: Adjustable, flat, corrugated or perforated T-shaped to suit frame size, with leg not less than 2" wide by 10" long. Furnish at least three anchors per jamb up to 7'-6" height; four anchors up to 8'-0" jamb height; one additional anchor for each 24" or fraction thereof over 8'-0" height.
 2. Metal Stud Partitions: Insert type with notched clip to engage metal stud, welded to back of frames. Provide at least four anchors for each jamb for frames up to 7'-6" in height; five anchors up to 8'-0" jamb height; one additional anchor each 24" or fraction thereof over 8'-0" height.
 3. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8" concealed bolts into expansion shields or inserts at 6" from top and bottom and 26" o.c., unless otherwise shown. Reinforce frames at anchor locations. Apply removable stop to cover anchor bolts unless otherwise indicated.
- G. Floor Anchors: Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 14 gage galvanized steel sheet as follows:
 1. Monolithic Concrete Slabs: Clip type anchors with two holes to receive fasteners, welded to bottom of jambs and mullions.
- H. Head Anchors: Provide two anchors at head of frames exceeding 42" wide for frames mounted in steel stud walls.
- I. Head Strut Supports: Provide 3/8" x 2" vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable bolted anchorage to frame jamb members.

- J. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations which are to be built into frame.
 - K. Head Reinforcing: For frames over 4'-0" wide in masonry wall openings, provide continuous steel channel or angle stiffener not less than 12 gage for full width of opening welded to back of frame at head.
 - L. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.
 - M. Rubber Door Silencers: Except on weatherstripped doors, drill stops to receive three silencers on single-door frames and four silencers on double door frames. Install plastic plugs to keep holes clear during construction.
 - N. Plaster Guards: Provide 26 gage steel plaster guards or dust cover boxes, welded to frame at back of finish hardware cutouts where mortar or other materials might obstruct hardware installation.
- 2.05 STOPS AND MOLDINGS:
- A. Provide stops around glazed panels in hollow metal units and in frames to receive doors where indicated.
 - B. Form fixed stops integral with frame, unless otherwise indicated.
 - C. Provide removable stops and molds where indicated or required, formed of not less than 20 gage steel sheets matching steel on frames. Secure with countersunk machine screws spaced uniformly not more than 12 o.c.. Form corners with butted hairline joints.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine substrate and conditions under which hollow metal work is to be installed and must notify Contractor, in writing, of any conditions detrimental to proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION:

- A. Install hollow metal units and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- B. Setting Masonry Anchorage Devices:
 - 1. Provide masonry anchorage devices where required for securing hollow metal frames to in-place concrete or masonry construction.
 - 2. Set anchorage devices opposite each anchor location, in accordance with details on final shop drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris.
 - 3. Floor anchors may be set with powder-actuated fasteners instead of masonry anchorage devices and machine screws, if so indicated on final shop drawings.
- C. Placing Frames:
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After all construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 2. Protective Coating: In masonry walls, protect inside (concealed) faces of door frames using fibered asphalt emulsion coating. Apply approximately 1/8" thick over shop primer and allow to dry before handling.
 - 3. In masonry construction, building-in of anchors and grouting of frames is included in Section 04300 of these specifications.
 - 4. At in-place concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices.
 - 5. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.
 - 6. Make field splices in frames as detailed on final shop drawings, welded and finished to match factory work.

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7. Remove spreader bars only after frames or bucks have been properly set and secured.

D. Door Installation:

1. Fit hollow metal doors accurately in their respective frames with the following clearances:
 - a. Jambs and Head: $3/32$ ".
 - b. Meeting Edges, Pairs of Doors: $1/8$ ".
 - c. Bottom: $1/4$ " at threshold or carpet.
 - d. Bottom: $1/4$ " to threshold or tile.
 - e. Head: $1/8$ " to bottom of head or transom panel.
2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.
3. Finish Hardware installation is specified in Section 08710.

3.03 ADJUST AND CLEAN:

- A. Final Adjustments: Check and re-adjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating conditions. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.
- B. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

END OF SECTION 08112

SECTION 08210 - FLUSH WOOD DOORS

PART 1. GENERAL

1.1 SECTION INCLUDES: Wood doors non-rated and fire-rated

- A. Solid core flush wood doors

1.2 RELATED SECTIONS

- A. Section 08112 - Hollow metal work
- B. Section 08710 - Finish hardware

1.3 REFERENCES AND REGULATORY REQUIREMENTS

- A. ASTM E152 - Methods of Fire Tests and Door Assemblies.
- B. NFPA 252 - Standard Methods for Fire Assemblies.
- C. UBC 7-2-1994
- D. UBC 7-2, 1997
- E. MBC 2009
- F. UL 10 (c) - Fire Tests for Door Assemblies - Positive Pressure
- G. UL 10 (b) - Fire Tests for Door Assemblies - Neutral Pressure
- H. NFPA 80 - Fire Doors and Windows.
- I. Quality Standards:
 - 1. WDMA Industry Standard I.S. 1A-04
 - 2. ANSI A115. W Series, Wood Door Hardware Standards. (American National Standard Institute)
- J. Labeling Agencies
 - 1. Intertek Testing Services-Warnock Hersey (ITS-WH)
 - 2. Underwriters Laboratories (UL)

1.4 SUBMITTALS

- A. Shop drawings: Indicate location, size, and hand of each door; elevation of each kind of door; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire ratings for fire doors.

- B. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Faces for Factory Finished doors: Show the full range of colors available for stained finishes.

- C. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide one piece of the expected finished work.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain flush wood doors through one source from a single manufacturer.

- B. Quality standard: Comply with WDMA I.S.1-A 04

- C. Fire-rated Doors: Doors 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 UBC 7-2-1997 (Positive Pressure)

1.6 DELIVERY STORAGE AND HANDLING AND SITE CONDITIONS

- A. Deliver, store, protect and handle products under provisions of WDMA.

- B. Package doors individually and wrap bundles of doors. Inspect for damage. Do not store in damp or wet areas. HVAC systems should be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25% nor greater than 55%.

- C. Certain wood species are light sensitive. Protect doors from exposure to natural and artificial light after delivery.

1.7 WARRANTY

- A. Provide manufacturer's warranty for Interior Solid Core Doors:
 - 1. Full Lifetime Warranty

PART 2. PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Flush wood doors:
 - a. Marshfield DoorSystems. Basis of Design-Signature Series Doors
 - 2. Or Equal Products by:
 - a. Algoma Hardwoods, Inc.
 - b. Eggers Industries
 - c. Oshkosh Door Company
 - d. Mohawk Flush Doors - Masonite Company
- B. Substitutions allowed only with written approval by architect prior to bid date.

2.2 DOOR CONSTRUCTION, GENERAL

- A. WORKMANSHIP
 - 1. Comply with WDMA I.S. 1A-04
- B. PERFORMANCE STANDARD
 - 1. Comply with WDMA I.S. 1A-04 Extra Heavy Duty
- C. DOORS FOR TRANSPARENT FINISH:
 - 1. Grade: Premium, with A Grade Faces
 - 2. Wood veneer Species and Cut: Plain sliced red oak
 - 3. Match between veneer leaves: Book match
 - 4. Assembly of spliced veneers: Running
 - 5. Pair and Set match: Provide for doors hung in same opening or separated only by mullions.
 - 6. Door with Transom: Continuous match
- D. DOORS FOR OPAQUE FINISH:
 - 1. Medium Density Overlay

- E. Interior Veneer-faced doors:
 - 1. Stiles and rails bonded to core, then entire unit abrasive planed before veneering.
- F. Rating: Positive pressure Category A (concealed intumescent).

2.3 SOLID-CORE DOORS

A. NON-FIRE RATED WOOD DOORS

- 1. Non-rated and 20-minute rated
 - a. LD-2 Particleboard, PC-5
 - b. Structural Composite Lumber, SCLC-5
 - c. Stave lumber core, SLC-5
- 2. Provide manufacturers standard laminated-edge construction with improved screw-holding capability and split resistance.
- 3. 20-minute rated pairs:
 - a. Provide with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.
 - b. As required by manufacturer to permit positive pressure "S" label per Category H.

B. FIRE RATED WOOD DOORS

- 1. Manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
- 2. Blocking: provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware for surface applied hardware.
- 3. Provide manufacturers standard laminated-edge construction with improved screw-holding capability and split resistance that are labeled and listed to provide fire rating indicated.

4. Pairs: Metal edges.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 - 1. WDMA prefit clearances for factory fit doors
 - 2. NFPA 80 for fire rated doors
 - 3. Manufacturers hardware templates
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, and hardware templates.
 - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standard for kind(s) of doors(s) required.
 - 1. Light openings: Trim openings with moldings of material and profile indicated.
 - 2. Louvers: Factory install louvers in prepared openings.
- D. Apply appropriate labels.

2.5 FACTORY FINISH

- A. General: Comply with WDMA finish requirements.
- B. Finish doors at factory.
- C. Transparent Finish:
 - 1. Finish: WDMA TR-6 catalyzed polyurethane.
 - 2. Staining: As selected from manufacturers standard colors.
- D. Factory finished doors to be installed just prior to

substantial completion.

2.6 FACTORY GLAZING

- A. Glazing in wood doors to be installed by wood door manufacturer.

2.7 ACCESSORIES

A. GLAZING STOPS

- 1. Non-Rated:
 - a. Wood, of the same species/compatible with door species.
- 2. Fire-Rated:
 - a. Veneer wrapped rolled steel, of same species as door facing.

B. APPLIED MOLDINGS:

- 1. As selected from manufacturer's standard profiles and install as detailed.
- 2. Applied moldings to be affixed to the door without the use of nails or staples.

PART 3. EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects prior to hanging.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, Refer to Division 8 Section 08710 "Finish Hardware."
- B. Manufacturer's written instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

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1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

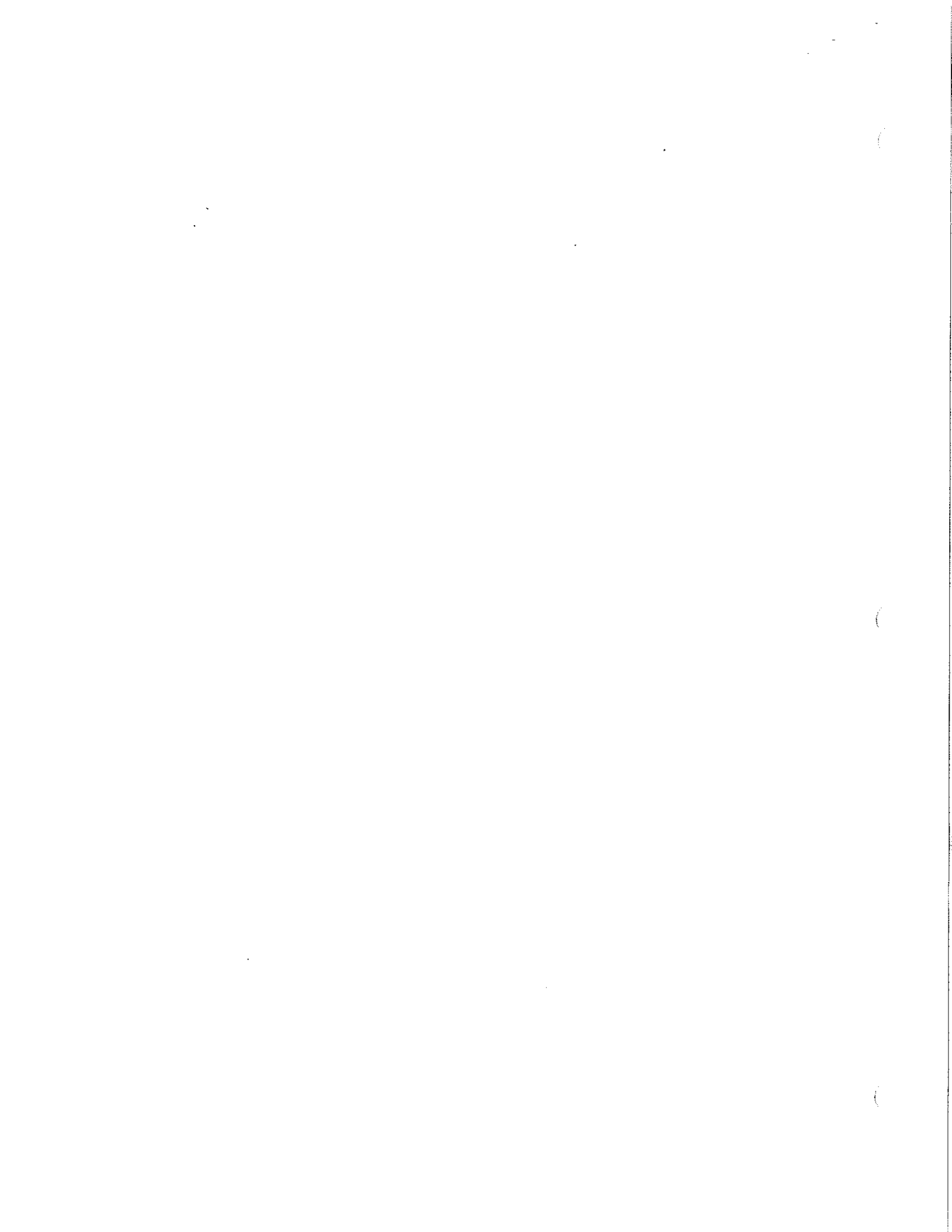
C. Align all doors for uniform clearance at each edge.

D. Factory finished doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Adjust all doors to swing and operate freely.

END OF SECTION 08210



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SECTION 08710 - FINISH HARDWARE

PART 1 - GENERAL

1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.

1.2 Work Included:

A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.

B. Related work:

1. Division 1 - General Requirements
2. Section 06100 - Carpentry
3. Section 08112 - Hollow Metal Doors and Frames
4. Section 08210 - Wood Doors
5. Section 08410 - FRP Doors and Aluminum Frames
6. Division 16 - Smoke Detection Systems
7. Division 16 - Security Access Systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:

1. Cabinet Hardware.
2. Signs, except as noted.
3. Chain link and wire mesh doors and gates
4. Access doors and panels

1.3 Quality Assurance

A. Requirements of Regulatory Agencies:

1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

B. Hardware Supplier:

1. Shall be an established firm dealing in contract builders' hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant (AHC).

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware 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, and who is acceptable to manufacturer of primary materials.

2. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-installation Meeting:

1. Before hardware installation, Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
2. When any electrical hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
3. Convene one week or more prior to commencing work of this Section.
4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.
3. Schedule will include the following:
 - a. Door Index including opening numbers and the assigned Finish Hardware set.
 - b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufac- turer B
Lock sets	Manufacturer X	Manufac- turer X
Kick Plates	Open	Manufac- turer Z

- c. Hardware Locations: Refer to Article 3.1 B.2 Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
- e. Hardware Description: Quantity, category, product number, fasteners, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. Scheduling Sequence shown in Hardware Sets.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. Electrified Hardware system operation description.
- j. **"Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."**

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- k. Typed Copy.
- l. Double-Spacing.
- m. 8-1/2 x 11 inch sheets
- n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:

- 1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
- 2. Submit product data with hardware schedule.

C. Samples:

- 1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
- 2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Key Schedule:

- 1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
- 2. Submit as a separate schedule.

E. Electrified Hardware Drawings:

- 1. Submit elevation drawings showing relationship of all electrical hardware components to door and frame. Indicate number and gage of wires required.
 - a. Include wiring drawing showing point to point wire hook up for all components.
 - b. Include system operations descriptions for each type of opening; describe each possible condition.

- F. Submit to Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
- 1.5 Product Delivery, Storage, and Handling:
- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.
- 1.6 Warranties:
- A. Refer to Division 1 for warranty requirements.
 - B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Replace work found to be defective as defined in the General Conditions.

PART 2 - PRODUCT

- 2.1 Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.
- 2.2 Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, it is understood that this is the owner's Building Standard and "no substitution" is allowed.

A. Hinges:

1. Furnish hinges of class and size as listed in sets.
2. Numbers used are Ives (IVE).
3. Products of a BHMA member are acceptable.

B. Continuous Gear Hinge:

1. 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pinless assembly, three interlocking extrusions, full height of door and frame, lubricated polyacetal thrust bearing, fasteners 410 stainless steel plated and hardened. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations at 5-1/8" spacing with a minimum of 16 bearings: and heavy duty at 2-9/16" spacing with a minimum of 32 bearings. Anodizing of material shall be done after fabrication of components so that all bearing slots are anodized.
2. Length: 1" less than door opening height. Fastener 12-24 x 1/2" #3 Phillips keen form stainless steel self-tapping at aluminum and hollow metal doors, 12-1/2" #3 Philips, flathead full thread at wood doors.
3. Furnish fire rated hinges "FR" at labeled openings.
4. Numbers used are Select Products, Ltd.
 - a. For Aluminum and FRP frames;
 - 1) Select Products Ltd. SL11HD

C. Locksets and Latchsets - Mortise Type:

1. Locksets shall be manufactured from heavy gauge steel, minimum lockcase thickness 1/8", containing components of steel with a zinc dichromate plating for corrosion resistance.
2. Locks are to have a standard 2 3/4" backset with a full 3/4" throw two-piece stainless steel mechanical anti-friction latchbolt. Deadbolt shall be a full 1" throw, constructed of stainless steel.
3. Lockcase shall be easily handed without chassis disassembly by removing handing screw on lockcase and installing in opposite location on reverse side. Changing of door hand bevel from standard to reverse

hand shall be done by removing the lockcase scalp plate, and pulling and rotating the latchbolt 180 degrees.

4. Lock trim shall be through-bolted to the door to assure correct alignment and proper operation. Lever trim shall have external spring cage mechanism to assist in support of the lever weight. Thumb turns shall have "EZ" thumbturn equal to IR-Schlage L583-363.
5. Function numbers are IR-Schlage.
 - a. IR-Schlage L9000
6. Lockset Trim:
 - a. IR-Schlage 93N
7. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond door frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

D. Exit Devices:

1. Exit devices shall be touchpad style, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.
2. All exit devices shall incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width. All latchbolts to be deadlatching type, with a self-lubricating coating to reduce wear.
3. End-cap will be sloped to deflect any impact from carts and they shall be flush with the external mechanism case. End caps that overlap and project above the mechanism case are unacceptable. End cap shall utilize a two-point attachment to the mounting bracket.
4. Touchpad shall match exit device finish, and shall be stainless steel for US26, US26D, US28, US32, and US32D finishes. Only compression springs will be used in devices, latches, and outside trims or controls.

5. Plastic templates shall be included with each exit device to facilitate a quick, easy and accurate installation.
 6. Strikes shall be roller type and come complete with a locking plate to prevent movement.
 7. All rim and vertical rod exit devices shall have passed a 5 million(5,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
 8. All mortise exit devices shall have passed a 10 million(10,000,000)cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
 9. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.
 10. Lever trim for exit devices shall be vandal-resistant type, which will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 11. IR-Von Duprin 98 Series. Series and function numbers as listed in sets.
 12. Trim:
 - a. As specified in sets.
 - b. Levers to match lockset design where specified.
- E. Electric Power Transfer:
1. Transfer power from door frame to edge of door, UL listed R4504.
 2. IR-Von Duprin EPT
- F. Removable Mullion:
- a. Interior/Exterior doors, mullion is removable only through the use of building keys.
 - 1) IR-Von Duprin KR4954
 - b. Interior Doors - UL listed, Mullion is removable only through the use of building keys.
 - 1) IR-Von Duprin KR9954

G. Push and Pull Hardware:

1. Push Plates: Ives 8200 Series 6 x 16 x .050 inches.
If stile widths will not accept 6 inches, provide
stile width less two inches.
2. Push Bars: IR-Von Duprin 330/350
3. Pull, Offset: One inch round rod, 90 degree offset,
12 inch centers.
4. Pulls: One inch round rod, straight 12 inch centers.
5. Pull Plates: IR-Ives 8303-8 4 x 16 x .050 inches.
8" center.
6. Pull, Wire: 3/4 inch diameter, 6 inch centers.
7. Vandal Resistant Pulls: IR-Ives VR900 Series.
Stainless steel construction 0.120 inches thick.
8. Manufacturer: Provide push and pull hardware from any
member of B.H.M.A.

H. Closers:

1. Door closers shall have fully hydraulic, full rack and
pinion action with a high strength cast iron cylinder.
Cylinder body shall be 1 1/2" in diameter, and double
heat treated pinion shall be 11/16" in diameter with
double D slab drive arm connection.
2. Hydraulic fluid shall be of a type requiring no
seasonal closer adjustment for temperatures ranging
from 120 degrees F to -30 degrees F.
3. Spring power shall be continuously adjustable over the
full range of closer sizes, and allow for reduced
opening force for the physically handicapped.
Hydraulic regulation shall be by tamper-proof, non-
critical valves. Closers shall have separate
adjustment for latch speed, general speed, and
backcheck.
4. All closers shall have solid forged steel main arms
(and forged forearms for parallel arm closers).
5. All surface mounted mechanical closers shall be
certified to exceed ten million (10,000,000) full load
cycles by a recognized independent testing laboratory.
6. Closers will have Powder coating finish certified to
exceed 100 hours salt spray testing by ETL, an
independent testing laboratory used by BHMA for ANSI
certification.

7. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
8. IR-LCN Series as listed in sets.

I. ADA Special Closers

1. Where "Low Energy Power Operated Door" as defined by ANSI Standard A156.19 is indicated for doors required to be accessible to the disabled, provide electrically powered 4640 Series operators complying with the ADA requirements for opening force and time to close standards.
2. Full closing force shall be provided when the power or assist cycle ends.
3. Modular design, adjustments easily accessible from the front, UL listed for use on labeled doors.
4. Shall have "Second Chance" function to accommodate momentary resistance, "Breakaway" function in the electronically controlled clutch, "Soft Start" motor control function and "Maintain Hold-Open Switch" to hold the door open at 90 degree.
5. Shall have built in 12V and 24V power supply for actuators, card readers, electric strikes and magnetic door locks, inputs for both swing and stop side sensors and available to accept either 120VAC or 220VAC input power. All wiring connections between operator modules made by easy-to-handle electrical connectors. Shall comply with both UL and NEC requirements for Class 1 and Class 2 wiring by providing separate conduits for each.
6. Shall have seven independent electronic adjustments to tailor the operator for specific site conditions. Opening speed, holding force at 90 deg., sequential trigger and time delay, hold-open time at 90 deg., opening force, clutch "breakaway" force setting, electric strike trigger and time delay.
7. Shall have separate and independent adjustments for back check, main speed and latch speed.
8. Furnish actuators and other controls as shown in Hardware Sets.

J. Overhead Holders and Stops:

1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
 - a. IR-Glynn-Johnson
 - b. Equal products of any BHMA manufacturer

K. Kick Plates:

1. Furnish .050 inches thick 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
2. Any BHMA manufacturing product meeting above is acceptable.

L. Wall Stops:

1. Length to exceed projection of all other hardware. Provide with threaded studs and expansion shields for masonry wall construction. Install with slope at top.
 - a. IR-Ives WS33(X)
 - b. BHMA L12011 or L12021

M. Wall Holders:

1. Products specified by series only; furnish strike length to exceed projection of all other hardware.
 - a. IR-Ives WS40
 - b. Equal products of any BHMA manufacturer

N. Door Holding Magnets:

1. Electrically controlled, fail-safe, holds door open until current is interrupted.

2. Furnish model to hold door away from wall to allow for any trim or levers on pull side of door.
 - a. IR-LCN SEM 7800 series

O. Thresholds:

1. 1/2" high - 5" wide. Cope at jambs.
2. Furnish full wall opening width when frames are recessed.
3. Cope in front of mullions if thresholds project beyond door faces.
4. Furnish with non-ferrous Stainless Steel Screws and Lead Anchors.
 - a. National Guard as listed in sets
 - b. Equal of Zero or Reese

P. Door Sweeps:

1. Surface Sweeps:
 - a. National Guard as listed in sets
 - b. Equal by Zero or Reese

Q. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

R. Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.
2. **Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.**

2.3 Finishes:

- A. Generally, Dull Chrome, US26D / BHMA 626. Provide finish for each item as indicated in sets.

2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 Cylinders and Keying:

- A. The Finish Hardware Supplier shall meet with Architect and Owner to finalize keying requirements and obtain keying instructions in writing. Supplier shall include the cost of this service in his proposal.
- B. Provide a cylinder for all hardware components capable of being locked.
- C. Provide cylinders factory master and grand master keyed to existing Bets system, according to Owner's instructions. Provide two change keys for each cylinder, three master keys for each master key set, and three grand master keys for system.
- D. Provide cylinders with removable construction cores for use during the construction period. When so directed, and in the presence of the Owner's security department or representative, Bets representative shall replace construction cores with final cores.
- E. Provide construction master keys as required by Contractor.

- F. Furnish visual key control - stamp key bows only with key set symbol.
- G. At the request of the Architect and when performing changeover from construction key system to final key system, deliver to the Architect or Owners Representative the following;
 - 1. Grand Master Keys
 - 2. Master Keys
 - 3. Extractor Key
 - 4. Copy of Finish Hardware Schedule

PART 3 - EXECUTION

3.1 Installation

A. General:

- 1. Install hardware according to manufacturers installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
- 2. Provide blocking/reinforcement for all wall mounted Hardware.
- 3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.
- 4. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
- 5. Continuous gear hinges attached to hollow metal doors and frames and aluminum doors and frames: 12-24 x 1/2" #3 Phillips Keenform self-tapping. Use #13 or 3/16 drill for pilot.
- 6. Continuous Gear Hinges require continuous mortar guards of foam or cardboard 1/2" thick x frame height, applied with construction adhesive.

7. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

B. Locations:

1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY

Hinges
Levers
Exit Device Touchbar
Wall Stops/holders

DIMENSION

Door Manufacturer's Standard
Door Manufacturer's Standard
Per Template
At Head

C. Final Adjustment:

1. Provide the services of a representative to inspect material furnished and its installation and adjustment, to make final hardware adjustment, and to instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets, closers and exit devices shall be inspected by the factory representative and adjusted after installation and after the HVAC system is in operation, to insure correct installation and proper adjustment in operation. The manufacturer's representative shall prepare a written report stating compliance, and also recording locations and kinds of noncompliance. The original report shall be forwarded to the Architect with copies to the Construction Manager, hardware distributor, hardware installer and building owner.

D. Technical and Warranty Information:

1. At the completion of the project, the technical and warranty information coalesced and kept on file by the Construction Manager shall be given to the Owner or Owner's Agent. In addition to both the technical and warranty information, all factory order acknowledgement numbers supplied to the Construction Manager during the construction period shall be given to the Owner or Owner's Agent. The warranty information and factory order acknowledgement numbers shall serve to both expedite and properly execute any warranty work that may be required on the various hardware items supplied on the project.
2. Submit to Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

3.2 Hardware Sets:

HW SET: 01

2	EA	CONTINUOUS HINGE	224HD	628	IVE
2	EA	FIRE EXIT HARDWARE	9827L-F-LBR 996L	626	VON
2	EA	RIM CYLINDER		626	
2	EA	SURFACE CLOSER	4111 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 1.5" LDW	630	IVE

HW SET: 02

1	EA	CONTINUOUS HINGE	224HD	628	IVE
1	EA	CLASSROOM LOCK	L9071BDC 03N	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33 (X)	626	IVE

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HW SET: 03

1	EA	CONTINUOUS HINGE	224HD	628	IVE
1	EA	STAFF PRIVACY SET	L9486L 03A L583-375 & L583-363	626	SCH
1	EA	MORTISE CYLINDER		626	
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33 (X)	626	IVE

HW SET: 04 (By "Eliason Corp.") For Food Service Doors

2	EA	DOUBLE ACTION "EASY SWING" HINGE			
2	EA	5" X 18" BOTTOM JAMB GUARD			
2	EA	HEAVY DUTY BOTTOM LEAF			
4	EA	PUSH PLATES (2 PER DOOR)			
2	EA	LOCK (TOGGLE SWITCH INSIDE/KEY OUTSIDE)			

END OF SECTION

SECTION 08810 - FIRE-RATED GLASS - FIRELITE PLUS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-rated glazing (FireLite Plus) materials installed as vision lights in fire-rated doors.
2. Fire-rated glazing (Pyrostop) materials installed as side-lights in fire-rated frames.

B. Related Sections include the following:

1. Section 08112 - Hollow Metal Work.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E2074-00: Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
2. ASTM E2010-01: Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.

B. American National Standards Institute (ANSI):

1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

C. Consumer Product Safety Commission (CPSC):

1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials.

D. Glass Association of North America (GANA):

1. GANA - Glazing Manual.
2. FGMA - Sealant Manual.

E. National Fire Protection Association (NFPA):

1. NFPA 80: Fire Doors and Windows.
2. NFPA 252: Fire Tests of Door Assemblies.

F. Underwriters Laboratories, Inc. (UL):

1. UL 10N: Fire tests of Door Assemblies.
2. UL10C: Positive Pressure Fire Tests of Door Assemblies.

- G. 2009 Michigan Building Code.
- H. NFPA 101 - 1997 Edition and Current Edition.

1.3 PERFORMANCE REQUIREMENTS

A. FireLite Plus

1. Fire-rated glass ceramic laminated, clear and wireless glazing material for use in impact safety rated locations such as doors with fire rating requirements ranging from 20 minutes to 3 hours with required hose stream test.

B. Pyrostop

1. Fire-rated, clear and wireless glazing material for use in locations such as doors and sidelites with fire rating requirements ranging from 45 minutes to 2 hours with required hose stream test; for use in interior and exterior applications.
2. Provides protection by reducing the radiant and conductive heat transfer

1.4 SUBMITTALS

- A. Comply with requirements of Section 01330.
- B. Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.
- C. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- D. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

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- E. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE

- A. Glazing Standards: FGMA Glazing Manual and Sealant Manual.
- B. Fire Resistance Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire resistive assemblies.
- C. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E-2074-00 and UL10B, labeled and listed by UL.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle materials under provisions of Section 01140.
- B. Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.
- C. Store off ground, under cover, protected from weather and construction activities.
- D. Do not expose Pilkington Pyrostop™ to temperatures greater than 120 degrees or less than minimum 40 degrees F during storage and transportation.
 - 1. Do not expose the non-PVB side of glass to UV light.
 - 2. Store sheets of glass vertically. DO NOT lean.

1.7 WARRANTY

- A. Provide manufacturer's limited warranty under provision of Division One.
- B. Warranty period: Five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 FIRE-RATED GLAZING MATERIALS

A. FireLite Plus: as manufactured by the Nippon Electric Glass Company, LTD and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065, voice 1-800-426-0279, fax 1-800-451-9857, e-mail sales@fireglass.com, Web site www.fireglass.com.

1. Properties:

- a. Thickness: 5/16".
- b. Weight: 4 lbs. /s.f.
- c. Approximate Visible Transmission: 85% +/-.
- d. Fire-rating: Provide ratings of 20-minute as indicated on drawings.
- e. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
- f. STC Rating: 35 dB +/-.

2. Maximum sheet sizes based on surface finish:

- a. Premium: 48 inches by 96 inches.

3. Permanently label each piece of FireLite Plus FireLite Logo, UL Logo and Fire rating in sizes up to 3,325 square inches and with the FireLite label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).

4. Fire Rating - Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2074-00, NFPA 252, UL 10B and UL10C.

5. Substitutions: Equal products by the following manufacturers will be considered:

- a. Pyran Platinum F by Safti as manufactured by O'Keefee's, Inc. Voice 1.888.653.3333, Web site <http://www.safti.com>.
- b. Pyran Star F by Interedge Technologies, Web site <http://www.firesafe-glass.com>.

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- B. Pilkington Pyrostop™ as manufactured by the Pilkington Group and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065, voice 1-800-426-0279, fax 1-800-451-9857, e-mail sales@fireglass.com, Web site www.fireglass.com.
1. Composition: Composed of multiple sheets of "Optiwhite" high visible light transmission glass laminated with an intumescent interlayer.
 2. Properties:
 - a. Thickness: For Interior Use: 1-7/16, Manufacturers designation 90-102.
 - b. Weight: 17.61 lbs. /s.f.
 - c. Approximate Visible Transmission: 85% +/-.
 - d. Fire-rating: 60 minute as indicated on drawings.
 - e. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
 - f. STC Rating: 45 dB +/-
 3. Permanently label each piece of Pilkington Pyrostop™ with the appropriate marking.
 4. Fire Rating - 60 Minutes and Greater: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E 119 and UL 263.
 5. Substitutions: Equal products by the following manufacturers will be considered:
 - a. Superlite II-XL as manufactured by O'Keeffee's, Inc. Voice 1.888.653.3333, Web site <http://www.safti.com>.
 - b. Pyrobel by Interedge Technologies, Web site <http://www.firesafe-glass.com>.

Equal products must pass both fire and hose stream test requirements and carry a permanent UL label when tested UL in accordance with ASTM E119 and UL263.

2.2 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

- A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, FireLite Plus glass panels that exceed 1,393 square inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by the manufacturer.
- B. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
 - 1. Dow Corning 795 - Dow Corning Corp.
 - 2. Silglaze-II 2800 - General Electric Co.
 - 3. Spectrem 2 - Tremco Inc.
- C. Setting Blocks:
 - 1. FireLite Plus:
 - a. Neoprene, EPDM or Silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
 - 2. Pyrostop:
 - a. Hardwood or calcium silicate; glass width by 4 inches by 3/16 inches thick.
- D. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.3 FABRICATION

- 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 recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Observable edge damage or face imperfections.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

- A. FireLite Plus
 - 1. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
 - 2. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
 - 3. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
 - 4. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
 - 5. Place setting blocks located at quarter points of glass with edge block no more than 6-inches from corners.

6. Glaze vertically into labeled fire-rated metal frames or partition walls with the same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
7. Place glazing tape on free perimeter of glazing in same manner described above.
8. Install removable stop and secure without displacement of tape.
9. Install in vision panels in fire-rated doors to requirements of NFPA 80.
10. Install so that appropriate UL and FireLite Plus markings remain permanently visible.

B. Pyrostop:

1. Comply with referenced GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
2. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
3. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
4. Place setting blocks located at quarter points of glass with edge block no more than 6-inches from corners.
5. Glaze vertically into labeled fire-rated metal frames or partition walls with the same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
6. Place glazing tape on free perimeter of glazing in same manner described above.
7. Do not remove protective edge tape.
8. Install removable stop and secure without displacement of tape.

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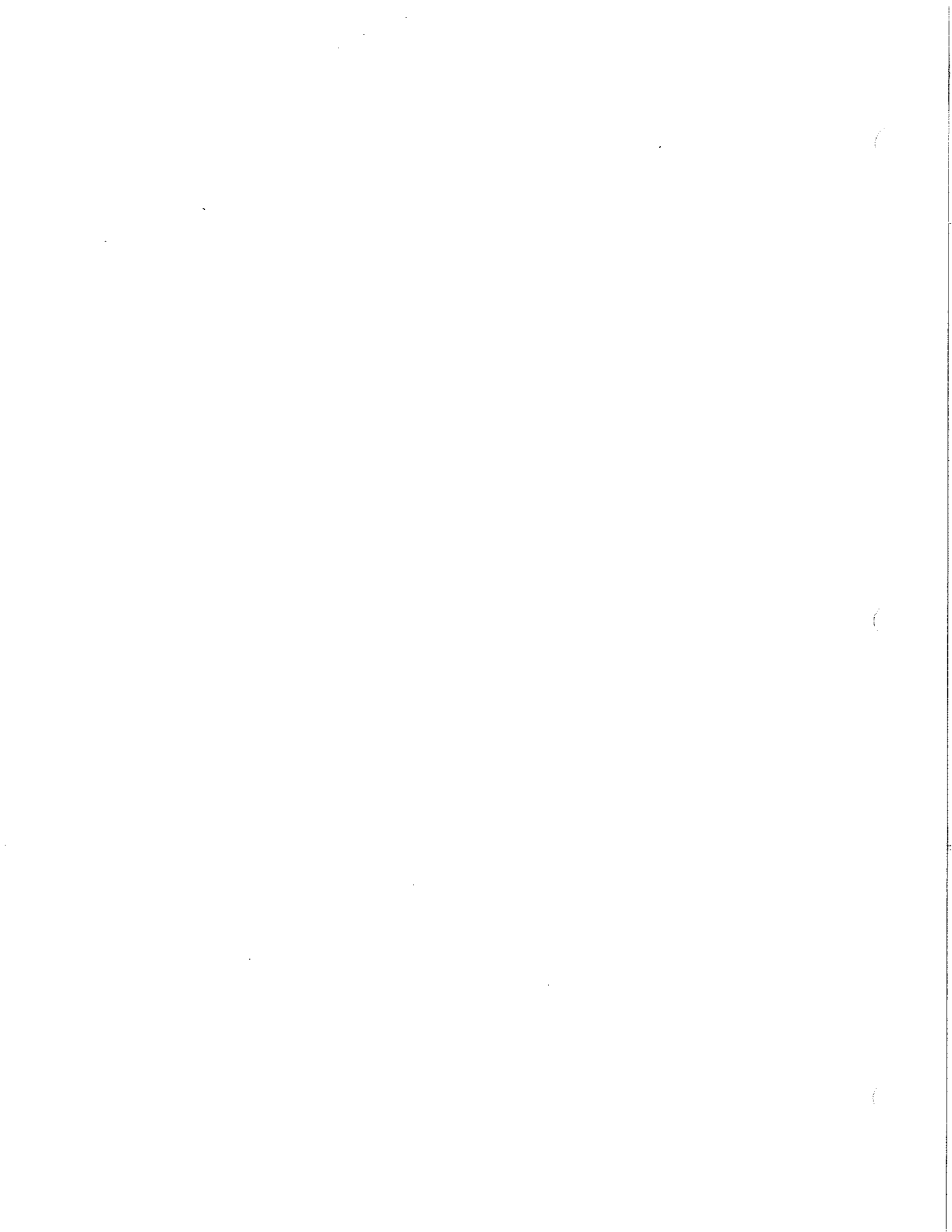
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9. Do not pressure glaze.
10. Glaze exterior openings with PVB layer toward the exterior of the building.
11. Knife trim protruding tape.
12. Apply cap bead of silicone sealant along void between the stop and the glazing, to uniform line, with bevel to form watershed away from glass. Tool or wipe sealant surface smooth.
13. Provide minimum 3/16 inch edge clearance.
14. Install in vision panels in fire-rated doors to requirements of NFPA 80.
15. Install so that appropriate UL and Pilkington Pyrostop™ markings remain permanently visible.

3.3 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

END OF SECTION 08810



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SECTION 09250 - GYPSUM DRYWALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Extent of each type of gypsum drywall construction required is indicated on Drawings.
- B. This Section includes the following types of gypsum board construction:
 - 1. Steel framing members to receive gypsum board.
 - 2. Gypsum board screw-attached to steel framing and furring members.

1.3 DEFINITIONS:

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this section or other referenced standards.

1.4 SUBMITTALS:

- A. Product data from manufacturers for each type of product specified.

1.5 QUALITY ASSURANCE:

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.
 - 1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in U.L. "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.

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- B. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.
- C. All gypsum board drywall and associated materials shall be manufactured domestically in the United States, by a United States Company and shall conform to ASTM Standards listed herein. Gypsum board drywall and associated materials shall not be imported, rebranded or distributed from another country.

1.6 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. Neatly stack gypsum boards flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS:

- A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.
- B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Steel Framing and Furring:
 - a. Clark Steel Framing.
 - b. Dietrich Industries, Inc.
 - c. Marino/Ware, Division of Ware Industries
 - d. Dale/Incor (Dale Industries)
 2. Gypsum Boards and Related Products:
 - a. Georgia-Pacific Corp.
 - b. Gold Bond Building Products Div., National Gypsum Co.
 - c. United States Gypsum Co.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS:

- A. General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.
- B. Concrete Inserts: Inserts designed for attachment to concrete forms and for embedment in concrete, fabricated from corrosion-resistant materials, with holes or loops for attachment of hanger wires and capability to sustain, without failure, a load equal to 3 times that imposed by ceiling construction, as determined from testing per ASTM E 488, conducted by an independent testing laboratory.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
- D. Channels: Cold-rolled steel, 0.0598 inch minimum thickness of base (uncoated) metal and 7/16 inch wide flanges, protected with rust-inhibitive paint, and as follows:
1. Carrying Channels: 1-1/2 inch deep, 475 lbs per 1000 ft., unless otherwise indicated.
 2. Furring Channels: 3/4 inch deep, 300 lbs per 1000 ft., unless otherwise indicated.
- E. Steel Studs for Furring Channels: ASTM C 645, with flange edges bent back 90 deg and doubled over to form 3/16 inch minimum lip (return), minimum thickness of base (uncoated) metal and minimum depth as follows:

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1. Thickness: 0.0329 inch, unless otherwise indicated.
 2. Depth: 3-5/8 inches, unless otherwise indicated.
- F. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 7/8 inches, and minimum thickness of base (uncoated) metal as follows:
1. Thickness: 0.0329 inch, unless otherwise indicated.
- G. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, complying with ASTM C 645 for material, finish and widths of face and fastening flange, fabricated to form 1/2 inch deep channel of the following configuration:
1. Single-Leg Configuration: Assymetric-shaped channel with face connected to a single flange by a single slotted leg (web).
- H. Grid Suspension System: ASTM C 645, manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS:

- A. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 deg and doubled over to form 3/16" minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Thickness: 0.0329 inch where indicated.
 2. Depth: 3-5/8 inches, unless otherwise indicated.
- B. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:
1. Depth: 7/8 inch.
 2. Thickness: 0.0329 inch, unless otherwise indicated.
- C. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

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D. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, complying with ASTM C 645 for base metal, finish and widths of face and fastening flange, fabricated to form 1/2 inch deep channel of the following configuration:

1. Single-Leg Configuration: Assymetric-shaped channel with face connected to a single flange by a single slotted leg (web).

E. Fasteners: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum drywall manufacturers for applications indicated.

2.4 GYPSUM BOARD:

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.

1. Thickness: Provide gypsum board in thicknesses indicated, or if not otherwise indicated, in either 1/2 inch or 5/8 inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.

B. Gypsum Wallboard: ASTM C1396, and as follows:

1. Type: Regular, unless otherwise indicated.

2. Type: Foil-backed where indicated.

3. Type: Type X for fire-resistance-rated assemblies.

4. Edges: Tapered.

5. Thickness: 1/2 inch, unless otherwise indicated.

6. Thickness: 5/8 inch where indicated.

7. Products: Subject to compliance with requirements, provide one of the following products where Type X gypsum wallboard is indicated:

a. "Gyprock Fireguard 'C' Gypsum Board"; Domtar Gypsum Co.

b. "Fire-Shield G"; Gold Bond Building Products Div., National Gypsum Co.

c. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; United States Gypsum Co.

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- C. Gypsum Backing Board for Multi-Layer Applications: ASTM C1396 or, where backing board is not available from manufacturer, gypsum wallboard, ASTM C1396, and as follows:
1. Type: Regular, unless otherwise indicated.
 2. Type: Foil-backed where indicated.
 3. Type: Type X for fire-resistance-rated assemblies.
 4. Edges: Manufacturer's standard.
 5. Thickness: 5/8 inch, unless otherwise indicated.
 6. Thickness: 1/2 inch where indicated.
- D. Water-Resistant Gypsum Backing Board: ASTM C1396, and as follows:
1. Type: Regular, unless otherwise indicated.
 2. Type: Type X for fire-resistance-rated assemblies.
 3. Thickness: 5/8 inch, unless otherwise indicated.
- E. Exterior Gypsum Soffit Board: ASTM C1396, with manufacturer's standard edges, of type and thickness indicated below:
1. Type: Regular, unless otherwise indicated.
 2. Type: Type X for fire-resistance rated assemblies.
 3. Thickness: 5/8 inch, unless otherwise indicated.
- F. Vandal Resistant Gypsum Board: ASTM C1629 (Noted as hi-impact gypsum board on wall types) Provide assembly consisting of 5/8" Hi-Impact brand XP gypsum wallboard as manufactured by National Gypsum with tapered edges with reinforced taped joints (profoam joint tape) and concealed with profoam ready mix or setting compounds and epoxy paint on finished surface, or equal as determined by Architect.
- G. Exterior Sheathing for EFIS Applications: ASTM C1177, C79 and C1396.
1. Type regular 1/2" thick, unless otherwise indicated.
 2. Type: Type x, 5/8" for fire rated applications.

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3. Provide glass-mat faced gypsum sheathing - DENSGLASS Gold or as manufactured by Georgia-Pacific Gypsum or Securock as manufactured by USG or equal as approved by Architect.

2.5 TRIM ACCESSORIES:

- A. Cornerbead and Edge Trim for Interior Installation:
Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal, plastic or metal combined with paper, with metal complying with the following requirement:
 - a. Sheet steel zinc-coated by hot-dip process.
2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 1047:
 - a. "LC" Bead, unless otherwise indicated.
 - b. "L" Bead where indicated.
 - c. "U" Bead where indicated.
3. One-Piece Control Joint: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

- B. Metal Cornerbead and Edge Trim for Exterior Ceilings:
Comply with the following requirements:

1. Edge trim complying with ASTM C 1047, formed from rolled zinc, shape "LC" Bead per Fig. 1, unless otherwise indicated.

2.6 GYPSUM BOARD JOINT TREATMENT MATERIALS:

- A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

- B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.

1. Use pressure sensitive or staple-attached open-weave glass fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

- C. Setting-Type Joint Compounds: Factory-prepackaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 - 1. Where setting-type joint compounds are indicated for use as taping and topping compounds, use formulation for each which develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.
 - 2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.
 - 3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer for this purpose.
- D. Drying-Type Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.
 - 1. Ready-Mix Formulation: Factory-premixed product.
 - 2. All-purpose compound formulated for use as both taping and topping compound.

2.7 MISCELLANEOUS MATERIALS:

- A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.
- B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum boards.
- C. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
- D. Fastening Adhesive for Wood: ASTM C 557.
- E. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum boards to steel framing.
- F. Gypsum Board Screws: ASTM C 1002.
- G. Gypsum Board Nails: ASTM C 514.

- H. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division-7 section "Joint Sealers."
- I. Sound Attenuation Blankets: Unfaced mineral fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:
 - 1. Mineral Fiber Type: Fibers manufactured from glass.
 - 2. Use in all partitions, full height to deck above.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

3.3 INSTALLATION OF STEEL FRAMING, GENERAL:

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

- C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on Drawings:
 - 1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.
 - 2. Where partition and wall framing abuts overhead structure.
 - a. Provide slip or cushioned type joints as detailed to attain lateral support and avoid axial loading.
- D. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.4 INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED
CEILINGS:

- A. Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to cast-in concrete inserts or other anchorage devices or fasteners as indicated.
 - 1. Do not attach hangers to metal deck tabs (where present).
 - 2. Do not attach hangers to metal roof deck (where present).
- B. Do not connect or suspend steel framing from ducts, pipes or conduit.
- C. Keep hangers and braces 2 inches clear of ducts, pipes and conduits.
- D. Sway-brace suspended steel framing with hangers used for support.
- E. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.
 - 1. Wire Hangers: 0.1620 inch diameter (8 gage), 4 ft. on center.
 - 2. Carrying Channels (Main Runners): 1-1/2 inch, 4 ft. on center.

3. Rigid Furring Channels (Furring Members): 16 inches on center.
 4. Rigid Furring Channels (Furring Members): 24 inches on center.
- F. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 ft. as measured both lengthwise on each member and transversely between parallel members.
- G. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
- H. For exterior soffits provide cross-bracing and additional framing indicated or required to resist wind uplift.

3.5 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS:

- A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other construction.
1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch from plane of 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.
- D. Terminate partition framing at suspended ceilings where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.
1. For single layer construction: 16 inches on center.
- F. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

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- G. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

3.6 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL:

- A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840.
- B. Install sound attenuation blankets in all partitions/shaft walls whether indicated or not and other locations where indicated, prior to gypsum board unless readily installed after board has been installed.
- C. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.
- D. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.
- E. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.
- F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

- G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- H. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.
- I. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
- J. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.
- K. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.
- L. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are braced internally.
 - 1. Except where 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. area, and may be limited to not less than 75 percent of full coverage.
 - 2. Fit gypsum board around ducts, pipes, and conduits.
- M. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.
- N. At all drywall partitions, seal construction at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim, and close off sound-flanking paths around or through construction, including sealing of partitions above acoustical ceilings.

- O. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.7 METHODS OF GYPSUM BOARD APPLICATION:

- A. Single-Layer Application: Install gypsum wallboard as follows:
 - 1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.
 - 2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
 - 3. On partitions/walls 8'-1" or less in height apply gypsum board horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.
- B. Wall Tile Base: Where drywall is base for thin-set ceramic tile and similar rigid applied wall finishes, install gypsum backing board.
 - 1. In "dry" areas install gypsum backing board or wallboard with tapered edges taped and finished to produce a flat surface.
 - 2. At showers, tubs and similar "wet" areas, install water-resistant gypsum backing board to comply with ASTM C 840 and recommendations of gypsum board manufacturer.
- C. Double-Layer Application: Install gypsum backing board for base layer and gypsum wallboard for face layer.
 - 1. On ceilings apply base layer prior to application of base layer on walls/partitions; apply face layers in same sequence. Offset joints between layers at least 10 inches. Apply base layers at right angles to supports unless otherwise indicated.
 - 2. On partitions/walls apply base layer and face layers vertically (parallel to framing) with joints of base layer over supports and face layer joints offset at least 10 inches with base layer joints.

- D. Acoustical Tile Base: Where drywall is base for adhesively applied acoustical tile, install gypsum backing board.
 - 1. Provide either V-joint type backing board or tape and finish joints to produce a flat surface.
- E. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:
 - 1. Fasten with screws.
- F. Double-Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:
 - 1. Fasten both base layers and face layers separately to supports with screws.
- G. Direct-Bonding to Substrate: Where gypsum board is indicated to be directly adhered to a substrate (other than studs, joists, furring members or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum board until fastening adhesive has set.
- H. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board perpendicular to supports, with end joints staggered over supports. Install with 1/4 inch open space where boards abut other construction.
 - 1. Fasten with cadmium-plated screws, or with galvanized or aluminum nails where supports are nailable.

3.8 INSTALLATION OF DRYWALL TRIM ACCESSORIES:

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.
- B. Install corner beads at external corners.
- C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.
 - 1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

2. Install "L" bead where edge trim can only be installed after gypsum board is installed.
 3. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- D. Install plastic edge trim where indicated on wall panels at juncture with ceilings.
- E. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

3.9 FINISHING OF DRYWALL:

- A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.
- B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.
- C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.
- D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat:
1. Embedding and First Coat: Setting-Type Joint Compound.
 2. Fill (Second) Coat: Setting-type joint compound.
 3. Finish (Third) Coat: Ready-mix drying-type all-purpose or topping compound.
- E. Finish exterior gypsum soffit board by using setting-type joint compounds to prefill joints, embed tape, and to apply first, fill (second) and finish (third) coats; smooth each coat before joint compound hardens to minimize need for sanding; sand between coats and after finish coat.
1. Painting of exterior gypsum soffit board after finish coat has dried is specified in Division-9 Section "Painting."

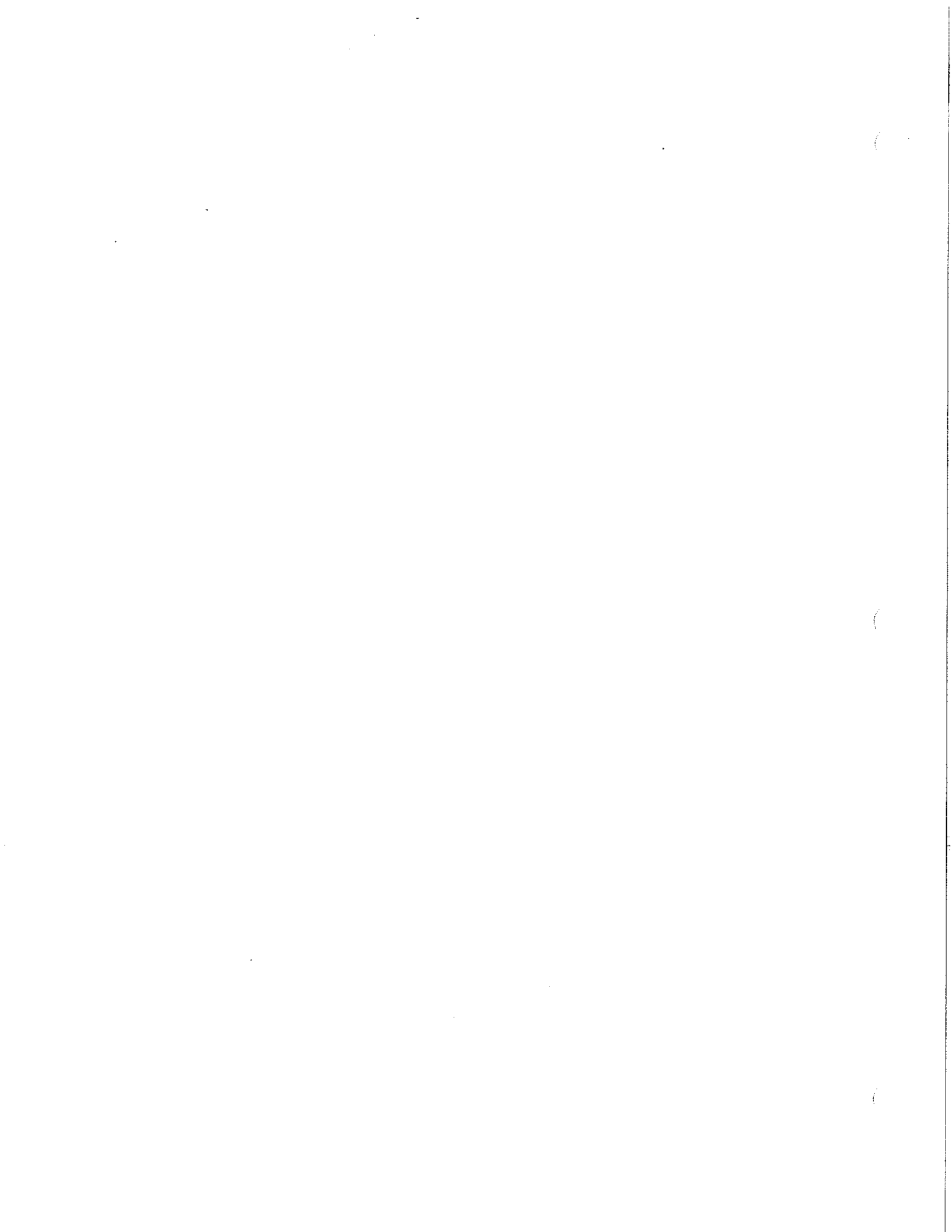
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- F. Water-Resistant Backing Board Base for Ceramic Tile:
Finish joints between water-resistant backing board with tape and setting-type joint compound to comply with gypsum board manufacturer's recommendations and installation standards referenced in Division-9 Section "Tile"
 - G. Base for Acoustical Tile: Where gypsum board is indicated as a base for adhesively-applied acoustical tile, install tape and 2- coat compound treatment, without sanding.
 - H. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.
- 3.10 PROTECTION:
- A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09250



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SECTION 09510 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of acoustical panel ceiling is shown on the drawings and in schedules.

1.03 QUALITY ASSURANCE:

- A. The installation of acoustical panel ceilings is to be by an experienced installation firm which is acceptable to the manufacturer of the acoustical units, as shown by current written statement from the manufacturer.
- B. Standard for Terminology and Performance: Applicable publications by the Acoustical and Insulating Materials Association (AIMA), including "Performance Data, Architectural Acoustical Materials."
- C. Fire Hazard Classification: UL tested, listed and labeled as Class 0.25.

1.04 SUBMITTALS:

- A. Product Data:
 - 1. For information only, submit 2 copies of manufacturer's product specifications and installation instructions for each acoustical panel ceiling material required, and for suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications. Distribute one additional copy of each installation instruction to the Installer.
 - a. Include manufacturer's recommendations for cleaning and refinishing acoustical panel, including precautions against materials and methods which may be detrimental to finishes and acoustical performance.

1.05 SAMPLES

1. Submit 3 sets of 12" square Samples for each acoustical panel required. In each set of samples show the full range of exposed color and texture to be expected in the completed work. Sample submittal and Architect's review will be for color and texture only. Compliance with other requirements is the exclusive responsibility of the Installer.
2. Submit 3, 12" long samples of exposed runner and molding. Architect's review will be for color and texture only. Compliance with other requirements is the exclusive responsibility of the Installer.

C. Maintenance Stock:

1. At the time of completing the installation, deliver stock of maintenance materials to the Owner. Furnish full size units matching the units installed, packaged with protective covering for storage and identified with appropriate labels. Furnish an amount equal to 5.0% of the amount installed.

1.06 JOB CONDITIONS:

- A. Space Enclosures: Do not install until interior acoustical panel ceilings unit space has been enclosed and is weather-tight, and until wet work in the space has been completed and is nominally dry and until work above ceilings has been completed, and until ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.01 CEILING UNITS:

A. Acoustical Panels:

1. Provide 24" x 48" wet-formed mineral fiber units not less than 3/4" thick. NRC 0.55, CAC 35, light reflectance 0.79, Square edge.

2. Basis of Design: Item #1715 Clean Room Mylar (field units) and #1720 Clean Room mylar border units (for use where panels must be cut on the jobsite), by Armstrong.
3. Install in 15/16" exposed tee grid.

2.02 CEILING SUSPENSION MATERIALS:

- A. General: Comply with ASTM C 635, as applicable to an intermediate duty suspension system. Coordinate with other work supported by or penetrating through the ceilings, including light fixtures and HVAC equipment.
- B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung.
 1. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, prestretched, yield-stress load of at least 3 times design load but not less than 12 USWG.
- C. Exposed Suspension System: Exposed systems compatible with tiles specified and as follows:
 1. Armstrong - 15/16" Prelude XL exposed tee grid.
 2. CertainTeed - 15/16" Classic Aluminum Capped Stab System.
 3. Donn - DX24 System; USG Interiors
 4. Chicago Metallic Corp: 1200 System.
- D. Edge Moldings: Manufacturer's standard channel molding for grid type used for edges and penetrations of ceiling, with a single flange of molding exposed, finish to match grid.

2.04 MISCELLANEOUS MATERIALS:

- A. Acoustical Sealant: A heavy-bodied, non-shrinking, non-drying, non-sag grade mastic compound intended for interior sealing of concealed construction joints.
- B. Tile Cement: As recommended by tile manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION WORK:

- A. Installer must examine the conditions under which the acoustical ceiling work is to be performed and notify the Construction Manager, in writing, of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid the use of less-than-half widths units at borders, and comply with reflected ceiling plans wherever possible.

3.02 INSTALLATION:

- A. General: Install material in accordance with manufacturer's printed instructions and comply with governing regulations as indicated, and industry standards applicable to the work.
- B. Install suspension systems to comply with ASTM C 636 with hangers supported only from building structural members as indicated. Locate hangers near each end and spaced 4' - 0' along direct-hung runners, unless otherwise indicated.
 - 1. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for the substrate, and which will not deteriorate or fail with age or elevated temperatures.
- C. Install edge moldings at edges of each acoustical ceiling area and at locations where edge of units would otherwise be exposed after completion of the work, except where adhesively applied.
 - 1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed pm back of vertical leg before fastening to vertical surface.
 - 2. Secure moldings to building construction by fastening with screw-anchors into the substrate through holes drilled in not more than 16" o.c. along each molding.

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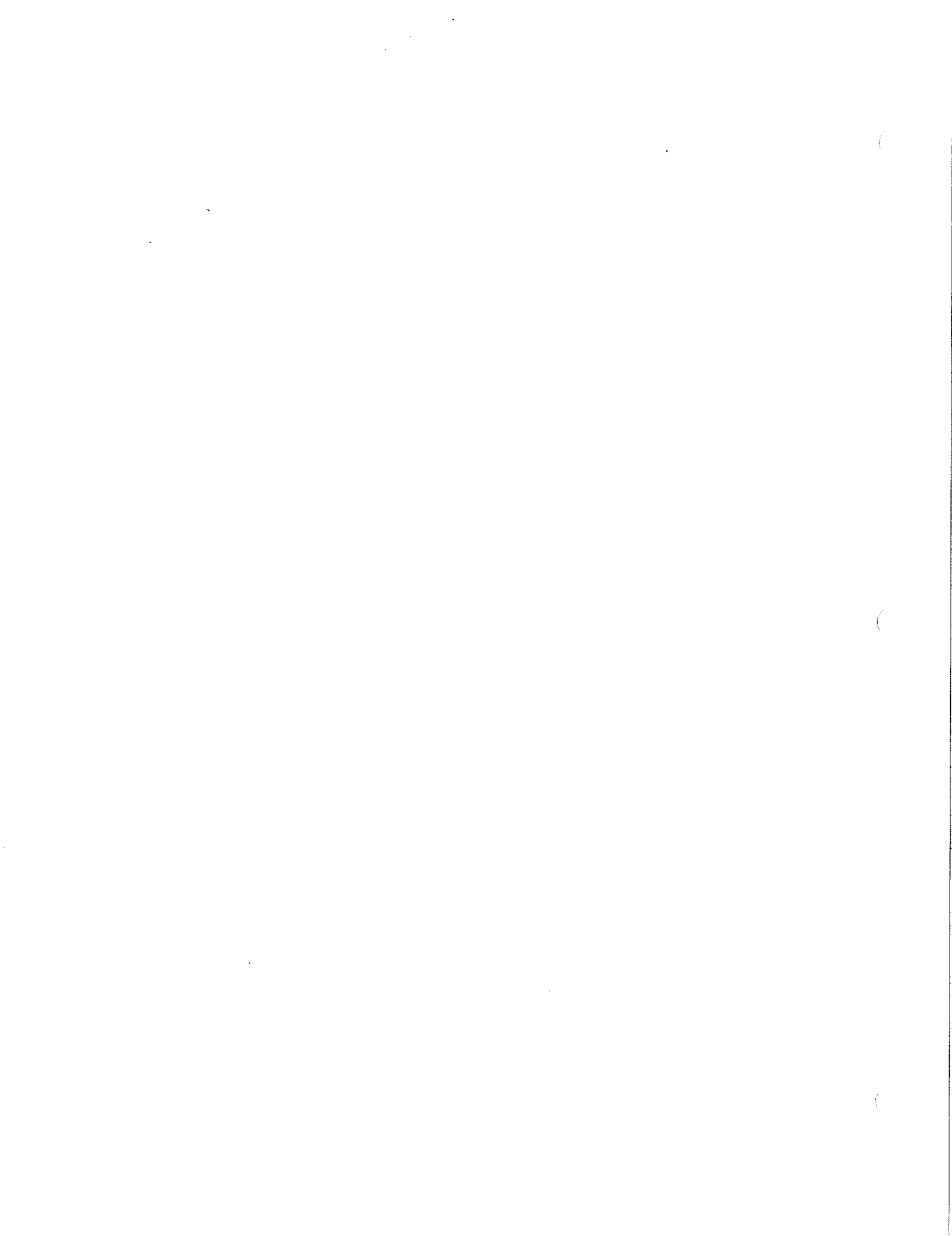
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3. Level moldings with ceiling suspension system to level tolerance of 1/8" in 12' - 0".
4. Miter corners of moldings accurately to provide hair-line joints, securely connected to prevent dislocation.
- D. Cope exposed flanges of intersection suspension system members so that flange faces will be flush (cope flange of member supported by other member) except as otherwise indicated.
- E. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at penetrations.
- F. Install edge trim moldings where indicated and elsewhere as needed to conceal edges of acoustical units which would otherwise be exposed to view after completion of the work. Anchor with fasteners, or if not possible, secure in place with permanent adhesive.

3.03 CLEANING AND PROTECTION:

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and required to permanently eliminate evidence of damage.
- B. The Installer shall advise the Construction Manger of required protection for the acoustical panel ceilings, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION 09510



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SECTION 09650 - RESILIENT FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of resilient flooring and accessories is shown on the drawings and in schedules.

1.03 QUALITY ASSURANCE:

- A. Wherever possible, provide resilient flooring and accessories produced by a single manufacturer.
- B. Fire Test Performance: Provide resilient flooring which complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.

1. Critical Radiant Flux (CRF): Not less than 0.45 watts per sq. cm. per ASTM E 648.
2. Flame Spread: Not more than 75 per ASTM E 84.
3. Smoke Developed: Not more than 450 per ASTM E 84.
4. Smoke Density: Not more than 450 per ASTM E 662.

1.04 SUBMITTALS:

- A. Product Data:
 1. For information only, submit 2 copies of manufacturer's technical data and installation instructions for each type of resilient flooring and accessory. Transmit a copy of each installation instruction to the Installer.

B. Samples:

1. Submit 3 sets of samples of each type, color and finish of resilient flooring and accessory required. Provide full-size tile units and 6" long sample of accessory. Include full range of flooring color and pattern variation. Sample submittals will be reviewed for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Maintenance:

1. Submit 2 copies of manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring and accessories.

1.05 JOB CONDITIONS:

- A. Continuously heat areas to receive flooring to 70 degrees F. for at least 48 hours prior to installation, when project conditions are such that heating is required. Maintain 70 degrees F. temperature continuously during and after installation, as recommended by flooring manufacturer, but for not less than 48 hours.

1.06 EXTRA STOCK

- A. Deliver to the Owner, for his use in future modifications, an extra stock of approximately 10% of each color and pattern in each material installed under this Section, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

PART 2 - PRODUCTS

2.01 TILE FLOORING:

- A. Vinyl Composition Tile: ASTM F-1066-95a CLASS 2 through pattern, 12" x 12" x 1/8" gage. (Note: Multiple colors will be used in various patterns. Refer to drawings for additional info).
 1. AZRock by Tarkett, Cortina colors, thru-chip floor tile (field and accents)
 2. AZRock by Tarkett, AZRock solids, thru-chip solid color floor tile (for accents)

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2.02 ACCESSORIES:

A. Resilient Base:

1. Provide vinyl base (Johnsonite vinyl wall base CB) complying with ASTM F-1861, Type TV, Group 1 (solid) in all areas except Admin. Areas and Media Center unless noted otherwise, as follows:

- a. Height: 4" refer to drawings for locations.
- b. Thickness: 1/8"
- c. Style: Standard top-set cove or straight type as indicated.
- d. Provide with preformed inside and outside colors.
- e. Provide with quarter round .5" high x .5" wide QTR-XX-A by Johnsonite at all interior door frames and door sidelight frames.
- f. Install per manufacturers specs to maintain warranty.
- g. Color: As selected by Architect. Provide 2 colors per room in pattern TBD.

B. Adhesives (cements): As recommended by flooring contractor to suit material and substrate conditions.

C. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which resilient flooring and accessories are to be installed and notify the Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION:

A. Prior to laying flooring, broom clean or vacuum surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.

1. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
2. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.
3. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.03 INSTALLATION:

A. General:

1. Install flooring after finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by flooring manufacturer.
2. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces, thresholds, nosing and edgings. Scribe around obstructions and produce neat joints, laid tight, even and straight. Extend flooring into toe spaces, door reveals and into closets and similar openings.
3. Maintain reference markers, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
4. Maintain overall continuity of color and pattern with pieces of flooring installed in these covers. Tightly cement edges to perimeter of floor around covers and to covers.
5. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks or other surface imperfections.

B. Tile Floors:

1. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.
2. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Cut tile neatly to around all fixtures. Broken, cracked, chipped or deformed tile are not acceptable.

C. Accessories:

1. Apply resilient base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in as long lengths as practicable, with preformed corner units or fabricated from base materials with mitered or coped inside corners. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces.
 - a. On masonry surfaces or other similar irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
2. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at all unprotected edges of flooring, unless otherwise shown.
3. Apply resilient accessories at stair systems as indicated and in strict conformance to manufacturer's installation instructions.

3.04 CLEANING AND PROTECTION:

- A. Remove any excess adhesive or other surface blemishes, using neutral type cleaners as recommended by flooring manufacturer. Protect installed flooring from damage by covering.

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- B. Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.
- C. Apply wax and buff with type of wax, number of coats and buffing procedures, in compliance with flooring manufacturer's instructions.

END OF SECTION 09650

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SECTION 09900 - PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of painting work is shown on the drawings and schedules, and as herein specified.
- B. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise indicated.
- C. The work includes field painting of exposed bare and covered pipe and ducts (excluding color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise indicated.
- D. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
- E. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers and other applied materials, whether used as prime, intermediate or finish coats.
- F. Paint all exposed surfaces in areas designated "paint" in "schedules," except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.

1.03 PAINTING NOT INCLUDED:

- A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications:
1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, and similar items.
 2. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, acoustic materials, casework, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, but not light or power panels where exposed elevator entrance frames, doors and equipment.
 3. Concealed surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas.
 4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.
 5. Operating Parts and Labels:
 - a. Moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise indicated.
 - b. Do not paint over any code-required labels, such as Underwriters', Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit 2 copies of manufacturer's technical information including paint label analysis and application instructions for each materials proposed for use. Transmit a copy of each manufacturer's instructions to the paint Applicator.

B. Samples:

1. Submit samples for Architect's review of color and texture only. Compliance with all other requirement is the Exclusive responsibility of the Contractor. Provide a listing of the materials and application for each coat of each finish sample.
 - a. On 12" x 12" hardboard, provide two samples of each color and material with texture to simulate actual conditions. Resubmit each sample as requested until acceptable sheen, color and texture is achieved.
 - b. On actual wood surfaces, provide two 4" x 8" samples of each stained wood finish as required. Label and identify each as to location and application.

1.05 DELIVERY AND STORAGE:

A. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Name or title of material.
2. Fed. Spec. Number, if applicable.
3. Manufacturer's stock number and date of manufacturer.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle.
6. Constituents.

7. Thinning instructions.
8. Application instructions.
9. Color name and number.

1.06 JOB CONDITIONS:

- A. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F. unless otherwise permitted by the paint manufacturer's printed instructions.
- C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.
 1. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.01 COLORS AND FINISHES:

- A. Prior to beginning work, the Architect will furnish color chips for surfaces to be painted. Multiple colors will be used and colors will vary from wall to ceiling and from room to room. Final selection for gloss level will be by Architect and may not necessarily be the same as scheduled.
 1. Use representative colors when preparing samples for review.
 2. Final acceptance of colors will be from samples applied on the job.
- B. Color Pigments: Pure, non-fading, applicable types to suite the substrates and service indicated.

- C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.02 EXTERIOR PAINT SYSTEMS:

- A. Metal-Galvanized (Semi-Gloss) :(Acrylic Latex System).
1. Finish Coats: 100 percent acrylic, Waterborne, Semi-Gloss (30-40 units at 60 degrees F.), 3.0 mils DFT/coat.
Benjamin Moore: (2) coats DTM acrylic semi-gloss (M29)

2.03 INTERIOR PAINTING SCHEDULE:

- A. Concrete/Masonry Surfaces (Semi-Gloss): (Water Based Epoxy - Normal Exposure)
1. Primer: 100 percent Acrylic Resin Block Filler, .075 - 1.0 DFT/coat.
Benjamin Moore: Waterborne block filler (M31/32)
 2. Finish Coats: Water Based Epoxy, Semi-Gloss (20-30 units at 60 degrees F.) 3 mils DFT/coat.
Benjamin Moore: (2) coats acrylic epoxy (M43/44)
- B. Gypsum Board (Semi-Gloss): (Water Based Epoxy System)
1. Primer: Vinyl Acrylic Latex, 1.1 mils DFT/coat
Benjamin Moore: Moorcraft undercoater (284)
 2. Finish Coats: Water Based Catalyzed Epoxy, Semi-Gloss (20-30 units at 60 degrees F.), 2.5 - 3.0 mils DFT/coat.
Benjamin Moore: (2) coats acrylic epoxy (M43/44)

- C. Stained Woodwork (Doors):
 - a. 1st Coat-Interior oil stain (TT-S-711)
 - b. 2nd Coat-Bleached shellac (TT-S-300)
 - c. 3rd Coat-Rubbing varnish (TT-V-86)
 - d. 4th Coat-Rubbing varnish (TT-V-86)
 - e. Fill open grained wood with filler complying with TT-F-336 and wipe before first varnish coat.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Applicator must examine the areas and conditions under which painting work is to be applied and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.
- B. Starting of painting work will be construed as the Applicator's acceptance of the surfaces and conditions within any particular area.
- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.02 SURFACE PREPARATION:

- A. General:
 - 1. Perform preparation and cleaning procedure in strict accordance with the paint manufacturer's instructions and as herein specified for each particular substrate condition.
 - 2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

B. Cementitious Materials:

1. Prepare cementitious surfaces to be painted by removing all efflorescence, chalk, dust, grease, oils, and by roughening as required to remove glaze conforming to SSPC SP13.
2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted by the manufacturer's printed directions.

C. Wood:

1. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of the priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried.
2. Prime, stain, or seal wood required to be job painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling, etc.
3. When transparent finish is required, use spar varnish for backpriming.
4. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

D. Ferrous Metals:

1. Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, conforming to SSPC SP-1 and SSPC SP-2, SSPC SP-3 or SSPC - SP7/NACE - No. 4 (brush off blast cleaning)

E. Galvanized Surfaces:

1. Clean free of oil and surface contaminants with an acceptable non-petroleum based solvent per SSPC SP-1.

3.03 MATERIALS PREPARATION:

- A. Mix and prepare painting materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce a mixture of uniform density and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

3.04 APPLICATION:

A. General:

1. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the substrate and type of material being applied.
2. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
4. Paint interior surfaces of ducts where visible through registers or grilles with a flat, non-specular black paint.
5. Paint the back sides of access panels and removable or hinged covers to match the exposed surfaces.
6. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.
7. Sand lightly between each succeeding enamel or varnish coat.
8. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting:

1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness:

1. Apply each material at not less than the manufacturer's recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

D. Mechanical and Electrical Work:

1. Painting of mechanical and electrical work is limited to those items exposed in occupied spaces and includes all exterior exposed work.

E. Prime Coats:

1. Apply a prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

F. Pigmented (Opaque) Finishes:

1. Completely cover to provide an opaque, smooth 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.

G. Transparent (Clear) Finishes:

1. Use multiple coats to produce glass-smooth surface film of each luster. Provide a finish free of laps, cloudiness, color, irregularity, runs, brush marks, orangpeel, nail holes, or other surface imperfections.
2. Provide satin finish for final coats, unless otherwise indicated.

H. Completed Work:

1. Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

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3.05 CLEAN-UP AND PROTECTION:

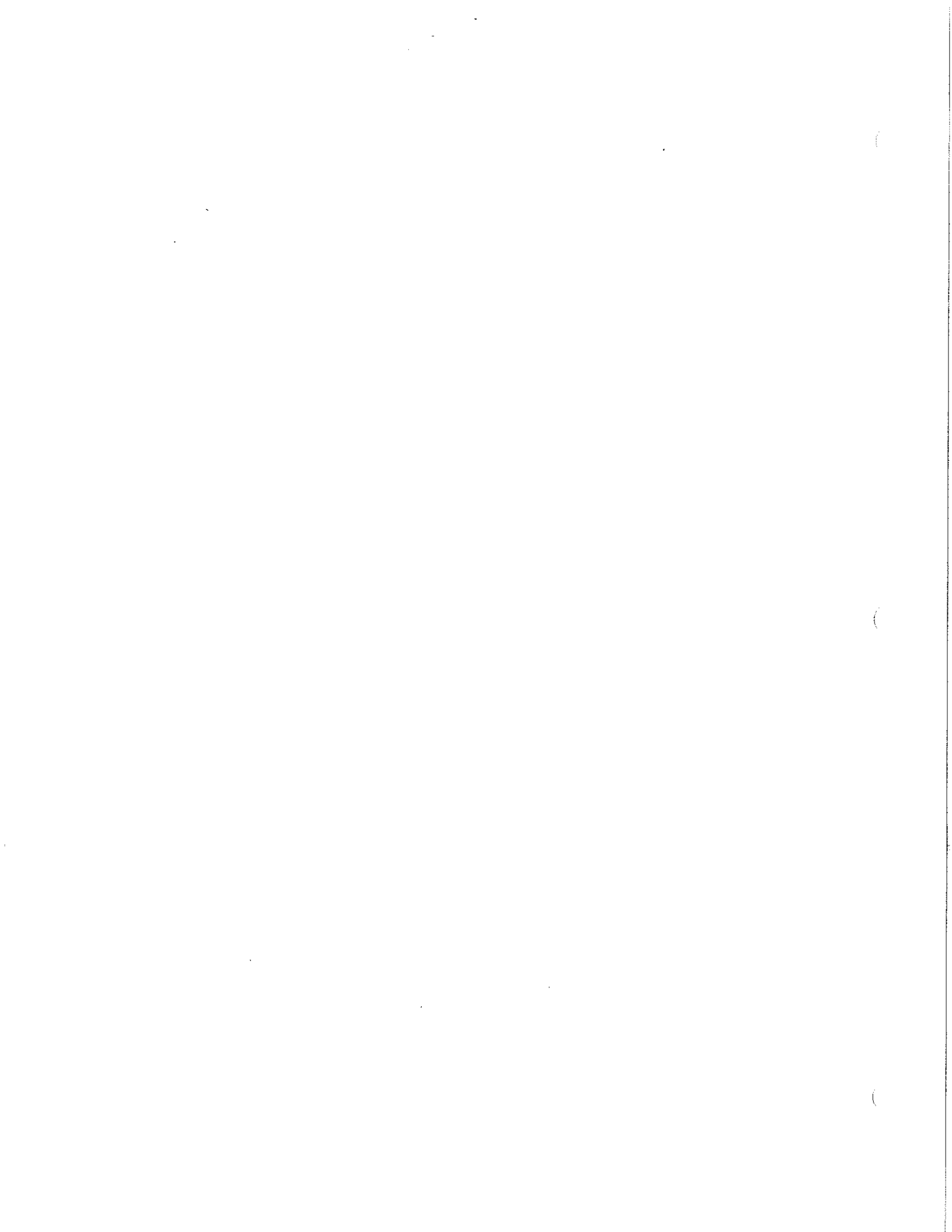
A. Clean-up:

1. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.
2. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection:

1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing and repainting, as acceptable to the Architect.
2. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION 09900



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SECTION 10522 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

- A. The extent of fire extinguishers and cabinets is shown on the drawings.

1.03 QUALITY ASSURANCE:

- A. Manufacturer: Provide fire extinguishers and cabinets manufactured by one of the following:

1. J. L. Industries
2. Larsens Manufacturing Company
3. Potter Roemer
4. Nystrom

1.04 SUBMITTALS:

- A. Manufacturer's Data:

1. For information only, submit two (2) copies of manufacturer's technical data and installation instructions for fire extinguisher cabinets required. Transmit copy of each instruction to the installer.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS AND CABINETS:

- A. General: Provide fire extinguisher cabinets including standard 10 lb. multi-purpose dry chemical fire extinguishers, as follows:

1. Surface mounted cabinet with solid door.

- B. Metal Gage: Provide cabinets fabricated of the following minimum equivalent steel gages.

1. Box: 20 gage.
2. Trim Frame: 18 gage.
3. Tubular Door Perimeter Frame: 20 gage:

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- C. Construction: One-piece tubular door frames, mitered and welded. One-piece metal trim frame, to suit cabinet style required. Weld all joints and grind smooth. Provide manufacturer's standard steel box with white baked enamel interior finish.
- D. Steel Doors and Trim: Manufacturer's standard, #4 stainless steel door frame and trim, style as indicated.
- E. Door Hardware: Continuous type hinge permitting door to open 180 degrees. Provide Futura "fire handle".
- F. Provide fire-rated cabinets where indicated on plan or if not indicated, at all locations installed in a fire-rated wall as shown on the life safety plan.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine the substrates and conditions under which the fire extinguisher cabinets are to be installed, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

- A. Install in locations and at mounting height to comply with governing authorities. Prepare recesses in walls as required. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.

END OF SECTION 10522

SECTION 10800 - TOILET ACCESSORIES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

- A. The extent of each type of toilet accessory is shown on the drawings.
- B. The type of toilet accessories required, provided by the Owner and installed by the Contractor, include the following:
 - 1. Soap dispenser
 - 2. Toilet tissue dispensers
 - 3. Towel Dispensers
- C. The type of toilet accessories to be provided and installed by the Contractor include the following:
 - 1. Mirrors
 - 2. Grab bars
 - 3. Misc. Accessories

1.03 QUALITY ASSURANCE:

- A. Inserts and Anchorages:
 - 1. Furnish inserts and anchoring devices which must be built into masonry for the installation of toilet accessories. Coordinate delivery with other work to avoid delay.
 - 2. See masonry sections of these specifications for installation of inserts and anchorage devices.
- B. Products:
 - 1. Provide products of the same manufacturer for units exposed in the same areas, unless otherwise acceptable to the Architect.

2. Stamped names or labels on exposed faces of units will not be permitted, except where otherwise indicated.
 3. Provide locks where indicated, with the same keying for each type of accessory units in the project wherever possible. Furnish two keys for each lock.
- C. The specifications indicated specific products of one manufacturer to communicate design intent. Other manufacturers offering products to comply with the requirements for toilet accessories include the following:
1. American Specialties, Inc.
 2. Accessory Specialties.
 3. Bradley Corporation
 4. Bobrick
- 1.04 SUBMITTALS:
- A. Product Data:
1. For information only, submit four (4) copies of manufacturer's technical data and installation instructions for each toilet accessory. Transmit copies of installation instructions to the Installer.
- B. Samples:
1. When requested, submit full-size samples of units to Architect for review of design and operation. Acceptable samples will be returned and may be used in the work. Compliance with all other requirements is the exclusive responsibility of the Contractor.
- C. Setting Drawings:
1. Provide setting drawings, templates, instructions and directions for installation of anchorage devices in other work.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Stainless Steel: AISI, Type 302/304 with polished No. 4 finish, 0.034 inch (22 gauge) minimum thickness.

- B. Brass: Unleaded , flat products, ASTM B19; rods, shapes, forgings, and flat products with finished edges, ASTM B16; castings, ASTM B30.
- C. Sheet Steel: Cold rolled, commercial quality, ASTM A336, 0.04 inch (20 gauge) minimum. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A527, G60.
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B456, Type SC2.
- F. Mirror Glass: Nominal 6.0mm (0.23 inch) thick, conforming to ASTM C1036, Type I, Class 1, Quality q2, and with silvering electro-plated copper coating, and protective organic coating.
 - 1. Provide tempered glass, unless indicated otherwise.
- G. Galvanized Steel Mounting Devices: ASTM A153, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.02 MIRRORS

- A. Stainless Steel Framed Mirror: Mirror shall have a one piece, Type 304 stainless steel angle frame, 3/4 inch by 3/4 inch with continuous integral stiffener on all sides and beveled front to hold frame tightly against mirror; corners shall be heliarc welded, ground and polished smooth; all exposed surfaces shall have satin finish with vertical grain. Tempered glass mirror shall be guaranteed for 15 years against silver spoilage. All edges shall be protected by plastic filler strips and the back shall be protected by full size, shock absorbing, water resistant, nonabrasive, 1/8 inch thick polyethylene padding. Galvanized steel back shall have integral hanging brackets for mounting on concealed rectangular wall hanger(s). Mirror shall be secured to hanger(s) with concealed phillips head jocking screws located in bottom of frame.
 - 1. Manufacturers: Subject to compliance with requirements, provide mirror unit by one of the following:
 - a. Bobrick: B-290. Provide with tempered glass.

2.03 GRAB BARS

- A. Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05 inch and as follows:
1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
 2. Clearance: 1-1/2 inch clearance between wall surface and inside face of bar.
 3. Gripping Surfaces
 - a. Satin finish with peened gripping surface, unless noted otherwise.
 4. Heavy Duty Size: Outside diameter of 1-1/2 inches minimum.
- B. Grab bar shall be constructed of Type 304 stainless steel with satin finish. Concealed mounting flanges shall be 1/8 inch thick stainless steel plate, 3-1/8 inch diameter, and each shall have 2 screw holes for attachment to wall. Flange covers shall be 22 gauge, 3-1/4 inch diameter by 1/2 inch deep, and shall snap over mounting flange to conceal mounting screws. Ends of grab bars shall pass through concealed mounting flanges and be heliarc welded to form one structural unit. Grab bars shall comply with ADA Accessibility Guidelines for structural strength. Provide concealed anchor device or backing as specified or required in accordance with local building codes before wall is finished.
1. Manufacturers: Subject to compliance with requirements, provide grab bars by one of the following:
 - a. Bobrick: B-6806.99 Series
 1. Horizontal: B-6806.99 by 36"
 2. Horizontal: B-6806.99 by 42"
 3. Vertical: B-6806.99 by 18"

2.04 MISCELLANEOUS ACCESSORIES

A. Mop and Broom Holders (MH): Surface mounted mop and broom holder shall be Type 304 stainless steel with satin finish. Unit shall be 36 inches long with 4 spring loaded, rubber cam holders. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

a. Bobrick: B-223-36

B. Trapwrap

1. Provide trapwrap where called for in schedule.
2. Trapwrap to be as manufactured by Brocar Products Inc. or TrueBro.

C. Fasteners and Anchors

1. Provide mounting kits with stainless steel screws for accessories requiring same.
2. Mounting kits shall include toggle nuts for hollow walls and expansion shields for solid walls. Provide 2 fasteners at each mounting plate.
3. Provide 12 gauge, 3 inches wide, steel concealed anchor plates with tapped holes for installation of grab bars on walls constructed with metal studs.
4. Provide concealed anchors for installation of grab bars on solid walls. Anchor assembly shall consist of tapped 12 gauge anchor plate, 10 gauge back plate, and 3/8 inch diameter thru-wall bolt.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which toilet accessories are to be installed and notify the Construction Manager in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

- A. Use concealed fastenings wherever possible.
- B. Provide anchors, bolts and other necessary anchorages and attach accessories securely to walls and partitions in locations as shown or directed.
- C. Install concealed mounting devices and fasteners fabricated of the same materials as the accessories, or of galvanized steel, as recommended by manufacturer.
- D. Install exposed mounting devices and fasteners finished to match the accessories.
- E. Provide theft-resistant fasteners for all accessory mountings.
- F. Secure toilet room accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.
- G. Schedule
 - 1. Toilet 106:
 - a. 1 ½" dia. grab bars, 36", 42" & 18" lengths (1 ea)
 - b. Toilet Tissue Dispenser (1)
 - c. Mirrors 24" x 36" (1)
 - d. Paper Towel Dispenser (1)
 - e. Soap dispenser (1)
 - f. Trap Wrap

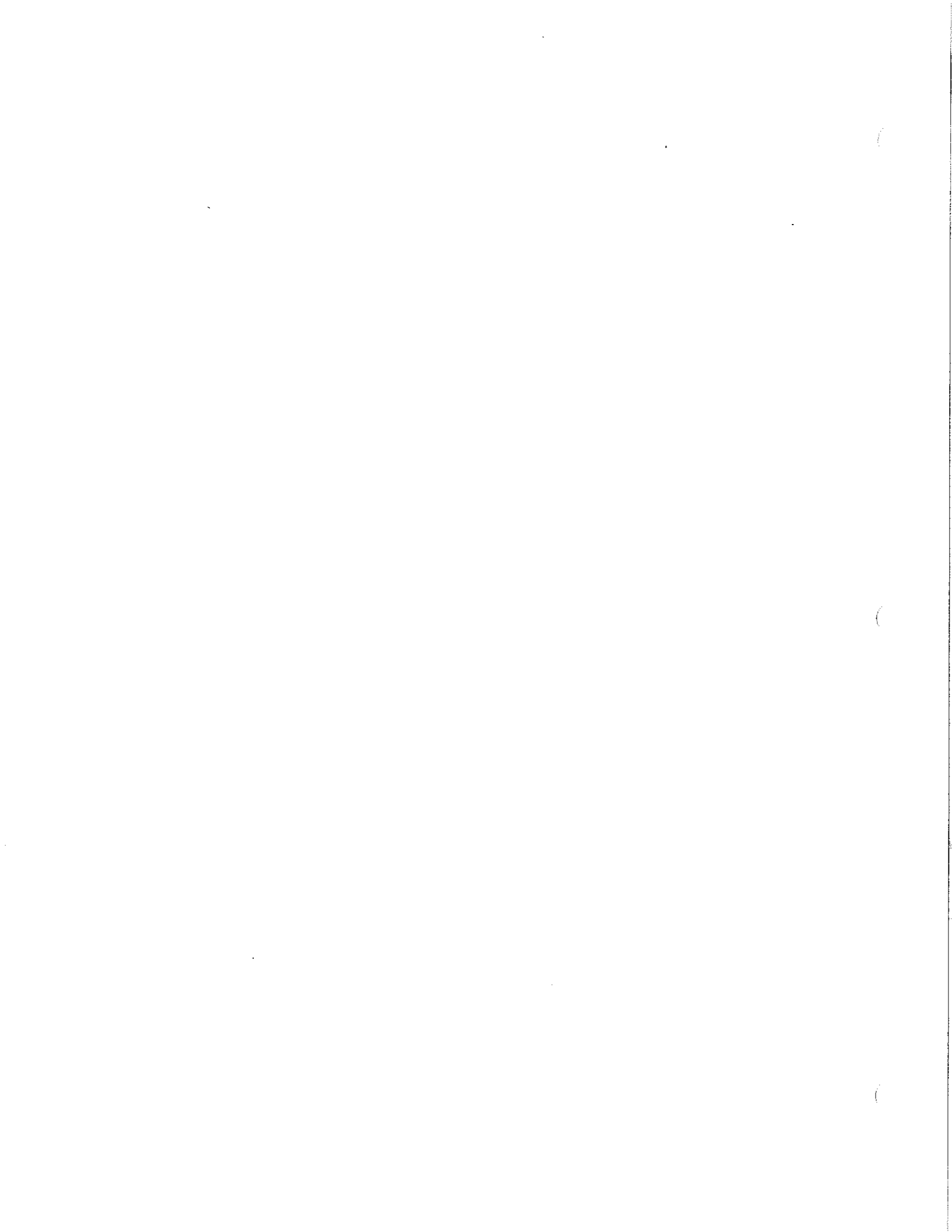
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2. Toilet 107:
 - a. 1 ½" dia. grab bars, 36", 42" & 18" lengths (1 ea)
 - b. Toilet Tissue Dispenser (1)
 - c. Mirrors 24" x 36" (1)
 - d. Paper Towel Dispenser (1)
 - e. Soap dispenser (1)
 - f. Trap Wrap
3. Custodian 111:
 - a. Mop and broom holder (1)

END OF SECTION 10800



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SECTION 11400 - FOOD SERVICE EQUIPMENT

GENERAL REQUIREMENTS

RELATED DOCUMENTS

The general provisions of the Contract, including instructions to bidders, General Conditions, Supplementary Conditions, General Requirements, apply to the work specified in this section.

1. DESCRIPTION

The fabrication requirements attached are a governing part of this specification and shall be consulted for all matters pertaining to the work. When references are made to FSEC, the same shall be construed to designate the Food Service Equipment Contractor.

The FSEC is to provide all items, articles, materials, transportation, operations, and methods listed, mentioned, or scheduled on the drawings and specifications, including all labor, materials, equipment, and incidentals necessary and as required for their completion.

2. QUALITY ASSURANCE

Brands and Names

The manufacturer's catalog designations used in the following specifications are intended to illustrate and represent the standards which will be required by the Owner. Bidders are to list, by item number, manufacturer's name and quantities on itemized proposal form attached to the specifications for approval by the Owner. When not attached, the FSEC shall make up his own itemized list and submit same attached with his bid.

NOTE! Base Bid must be on fixtures specified for fair comparison of all bids.

Substitutions

Substitutions by any bidder wishing to supply alternate equipment other than that specified may submit a separate itemized proposal on similar articles of other manufacturers of the same standard performance, capacity, size, durability and appearance but must accompany their alternate proposal with complete descriptive literature of the item quoted.

Owner and Architect reserve the right to accept or reject such proposed substitutions. Bidders recommending such substitutions are cautioned to examine the mechanical plans that may have already been approved and conditions at the building site to determine if such substitutions require changes in mechanical connections already planned or installed.

If the proposed substitutions require such changes, the Bidder shall include the cost of same in his bid and call it to the attention of the Architect and Owner by including a descriptive notation in his bid.

Discrepancies

Where model numbers, quantities, sizes or gauges of material differ on plans and specifications, it shall be understood that the FSEC shall figure the larger quantities, longest size and heavier gauge unless advised otherwise in writing.

Where an accessory or piece of equipment is shown on elevation or plan, it shall be deemed part of the Food Service Contract, even if it is not listed in the Item Specifications.

Where an item is listed in Item Specifications and not shown on plan or elevations, the item shall be deemed part of the Food Service Equipment Contract.

Measurements

All dimensions given on bidding are approximate and are as accurate as can be determined at the time. The Equipment Contractor shall check all measurements at the building prior to fabrication of equipment and shall bring any deviation from the dimensions shown or required by building conditions to the

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Consultant's attention. All equipment must conform to the finished building conditions. Where obstructions occur, equipment must be neatly scribed fitting to and around same resulting in a sanitary fixture.

Prior to fabrication, the Consultant or the Owner reserves the right to require the Contractor to make reasonable modifications in the routing of the work and relocation of the equipment. This specifically refers to conditions where interference occurs or where materials cannot be installed because of structural or mechanical conditions encountered. The Contractor will receive no additional compensation for such work.

Ordinances

Work and materials shall be in full accord with the latest rules of U.S. Public Health Service, National Board of Fire Underwriters, O.S.H.A., local and state ordinances, State Accident Commissions Safety Ordinances, regulations of the Bureau of Fire Services and with prevailing ordinances.

Ordinances including building codes, gas codes, steam codes, and other codes applying to this contract shall be followed.

All applicable items shall conform to latest Standards Revisions established by the National Sanitation Foundations, (N.S.F.), Ann Arbor, Michigan.

Electric operated and/or heated equipment, fabricated or otherwise shall conform to the latest standards of National Electric Manufacturer's Association, Underwriters Laboratories, Inc., National Electric Code or local standards such as to be acceptable to authorities having jurisdiction.

Standard steam heated equipment shall be manufactured in accordance with A.S.M.E. code requirements and carry the A.S.M.E. stamp.

Burners for gas heated equipment shall be equipped with automatic lighters. Oven burners and other concealed burners shall have automatic safety pilots and conform to A.G.A. standards. All gas equipment is to be furnished with appliance pressure regulators.

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The drawings and specifications shall govern whenever they require longer sizes or higher standards than are required by the ordinances.

The Ordinances shall govern whenever drawings and specifications require something which will violate the ordinances.

No extra change will be paid for furnishing items required by local and state ordinances not specified or shown on drawings. Rulings and interpretations of the enforcing agencies shall be considered as part of the ordinances.

Should any change in the drawings and specifications be required to conform to the above, the Architect shall be notified when bid is submitted.

After entering into contract, all necessary work shall be done to meet above laws, ordinances, Bureau of Fire Services Requirements, etc., without additional expense to the Owner.

Samples

Samples of all hardware, locks, feet, brackets, and other materials that may be requested shall be submitted for approval before use.

Scheduling of Work

The work shall be scheduled so there will be no interference with work of other trades and so that it will cause no delay. A time schedule will be worked out for the entire building and this work shall keep pace with the set schedule, working nights, Sundays and holidays, if necessary, to complete the work within the time limit.

3. SUBMITTALS

All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, Architect and Consultant. Submittals not bearing the FSEC's stamp will be rejected.

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FSEC shall submit required number of good quality reproducible vellum working drawings, brochures and portfolios of all equipment, apparatus, materials, etc., which are applicable to this contract together with detailed specifications. Each piece of equipment, apparatus, and accessory to be checked by the FSEC to insure compliance with requirements of Architect's drawings and specifications and also brochures or any other item of information to be clearly marked for identification with respect to their application and installation locations. This specification page shall appear on every shop drawing.

Approval and/or review of shop drawings, details, and equipment by the Consultant is for design and concept only and does not relieve the FSEC of responsibility for compliance with design drawings, details and specifications, verification of all dimensions of equipment and building conditions and reasonable adjustments due to deviations.

While the Architect's drawings and specifications propose to be complete in all respects as to layout, type of equipment and materials, they are not intended to serve as detailed sleeve or insert drawings, and preparation of such drawings, required or necessary for this purpose, or to set equipment accurately, are to be the responsibility of the FSEC.

FSEC shall submit vellum drawings of all custom fabricated equipment within thirty (30) days after notification of contract award. Drawings to be accurately laid out and correlated with other contractors work and latest architectural final construction plans. Equipment elevation shop drawings must be on 3/4" scale (3/4" = 1'-0").

Vellum drawings to show detailed construction for each piece of equipment. Before submitting detail drawings for review, they must be checked by the FSEC with the specifications and shall show exactly how item will be fabricated. Construction of equipment shall not deviate from approved shop drawings without written approval from the Architect and/or Food Service Consultant.

FSEC shall submit rough-in drawings on vellums for approval at a scale of 1/4" = 1'-0", locating accurately all utility connections for each item of equipment requiring the same.

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Rough-in plan to be drawn up using final architectural building drawings. NOTE! All rough-in connections to conform with normal acceptable standards. Rough-in requirements for present or future food service equipment shall be included on all drawings.

FSEC 1/4" scale rough-in drawings are to be dimensioned from ends of finished walls. Shop drawings with dimensions from centerline of columns will not be accepted, unless approval has been given by Architect, Consultant or the General Contractor.

Drawings showing all dimensions of bases or platforms and depressions to be submitted on a scale of 1/4" = 1'-0".

Rough in connection notes are not to be listed under numbered rough in schedule, except for general purpose outlets or where drawing space is limited.

Equipment rough in plans are to be furnished complete with layout plan and item schedule similar to food service consultants drawings. Plumbing, electrical, ventilation & depression plan, and base detail when required.

Plumbing and electrical plans are to be on separate sheets when drawings are prepared at 1/4" scale. NOTE! Food Service Consultants documents are not to be traced.

Manufacturers to strictly adhere to approved and reviewed drawings, except where field conditions require changes and in that event the Architect must be notified in writing.

Manufacturing of any equipment fitting between walls or between columns and walls to be withheld until actual field dimensions are set and approved by the General Contractor. All other items which do not require field dimensions are to be manufactured upon receipt of reviewed shop drawings.

Upon completion of contract, the contractor is to deliver to the Owner two (2) complete sets of final working drawings and two (2) portfolios of purchased equipment bound in a binder. A time schedule will be worked out for the entire building and this work shall keep pace with set schedule, working nights, Sundays, and holidays, if necessary, to complete the work within the time limit.

4. JOB CONDITIONS

Job Meetings

It shall be the responsibility of the FSEC to have a qualified representative at all monthly or special job meetings to help the Architect and other contractors on the job to correlate work or answer questions so that the job can progress without any obstructions.

Examination of Premises

FSEC to check the Architectural Contract Plans and visit the premises at a suitable time to determine maximum size of equipment he can safely get into the building in one piece. Field joints to be held to a minimum. Should door openings not be large enough, FSEC shall provide field joints in equipment as required and re-weld inside of building.

Utilities Services

Rough-in cold water, hot water, waste and vent piping, duct work and electrical wiring to be installed by Plumbing and Electrical Trades. Such items are to be brought away from surface of floors, walls and/or ceilings by these Trades and capped prior to installation of food service equipment.

5. GUARANTEE

FSEC is to furnish one (1) year written guarantee for equipment starting from date of acceptance by the Owner or the Owner's duly authorized representative. Guarantee to be in accordance with Architect's General Conditions.

Refrigeration - Self-contained

All self-contained refrigeration compressors for milk coolers, ice cream cabinets, cold food counters, reach in refrigerators or freezers, etc., shall be furnished with a five (5) year compressor warranty and one (1) year refrigeration service starting from date of final acceptance.

6. PRODUCTS

Fabrication Requirements - See following page for details

All food service equipment is to be constructed in strict compliance with the latest standards of the National Sanitation Foundation and to meet all requirements of the local and State Health Regulations. All equipment to bear the N.S.F. seal of approval.

Welding

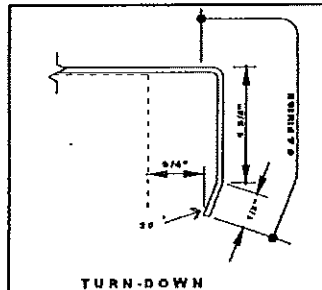
The words "weld", "welded", or "welding" as used in the item specifications, mean a metal joint continuously welded then all exposed parts ground smooth and polished to match adjoining surfaces.

All welding to be done in a thorough manner with welding rod of same composition as sheets or parts welded. Welds to be strong, ductile with excess metal and discoloration ground off and joint finished smooth to match adjoining surfaces.

Welds to be free of imperfections such as pits, runs, splatters, cracks, warping or discoloration. All welded joints to be homogeneous with parent metal itself. All fabricated equipment items where metal to metal butt joints occur to be joined and properly welded then ground and polished smooth.

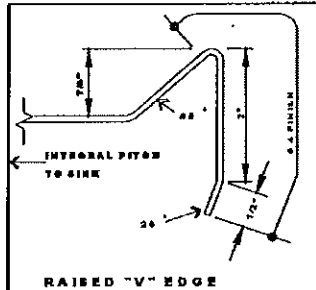
Grinding, Polishing and Finishing

All exposed welded joints to be ground flush with adjoining material and neatly finished to harmonies therewith.



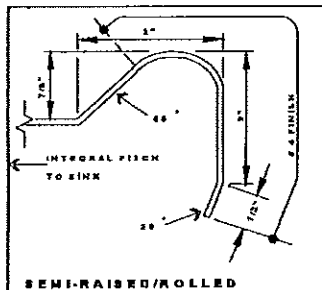
TURN-DOWN

TYPE "A" EDGE



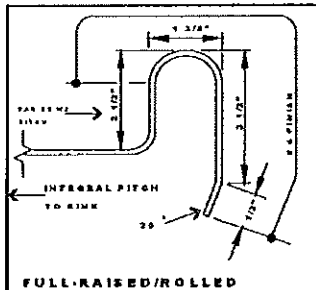
RAISED "V" EDGE

TYPE "B" EDGE



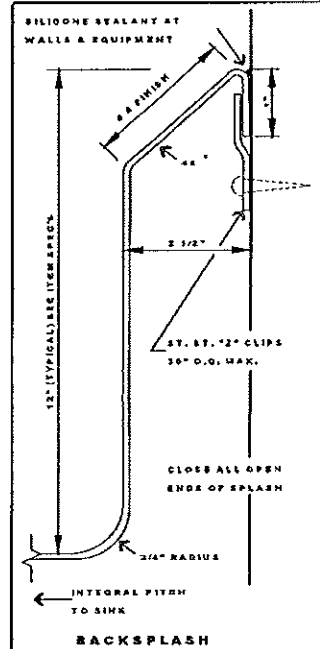
SEMI-RAISED/ROLLED

TYPE "C" EDGE



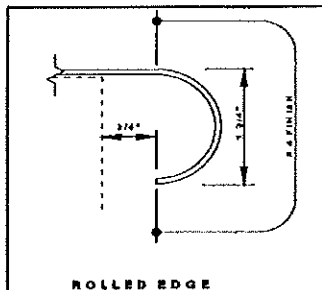
FULL-RAISED/ROLLED

TYPE "D" EDGE



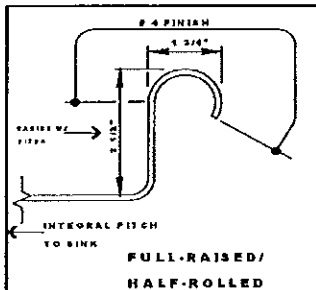
BACKSPLASH

TYPE "G" EDGE



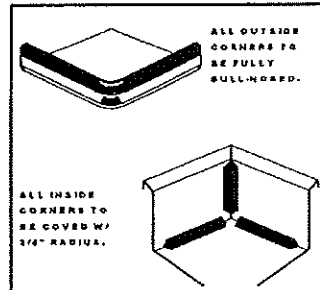
ROLLED EDGE

TYPE "E" EDGE



**FULL-RAISED/
HALF-ROLLED**

TYPE "F" EDGE



CORNERS

STANDARD EDGE DETAILS

NO SCALE

Whenever material has been depressed or sunken in by welding operations, such depressions shall be suitably hammered and peened flush with adjoining surfaces to then be polished and/or buffed to match adjoining surfaces to a degree consistent with good workmanship. Care shall be exercised in all grinding operations to avoid excessive heating of metal and metal discoloration. Abrasive wheels and belts used in grinding to be iron free and not having been used on carbon steel. In all cases, the grain or rough finish to be removed by successively finer polishing operations to be consistent with reasonable care and good workmanship. Final polishing operations to be uniform and smooth.

Where break band occurs, free of open texture or orange peel appearance, all such marks shall be removed by grinding, polishing and finishing. Wherever sheared edges occur, they shall be free from burrs, projections and fins to obviate all danger from cutting or laceration when hand is drawn over such sheared edges.

Where miters or bullnosed corner, they will be neatly ground to uniform condition and in no case will overlapping materials be acceptable.

Equipment quality finish consistent with high grade of manufacturing practiced in industry. All exposed surfaces to be commercial mill finishes known as #4 satin finish for corrosion resistant steel. All exposed edges to be furnished with a #7 mirror finish, unless otherwise noted in item specifications.

All cabinets, doors and shelves where exposed to be interpreted as meaning inside surface exposed to view when swinging door or sliding doors are opened. Unless otherwise specified, underside of shelves need not be satin finish.

Doors - Hinged

To be full height of door opening. Each door shall not be over 30" wide for high cabinets and 24" wide for low cabinets. Doors to be double pan construction flush type and braced and thoroughly sound deadened made of 18 ga. st. st. Inner and outer pans to be sealed with 3/4" long tack welds spaces

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approximately 6" apart. Balance of the space to be completely sealed between tack welds with silver solder or N.S.F. approved hard solder (Silicone not approved).

All welds ground and polished smooth. All bracings to be on proper centers to fit door size.

Doors to be mounted on heavy semi concealed nickel bronze olive knuckle hinges fastened to inside ledge of door and cabinet so that only pin will be exposed to heavy st. st. piano hinges. Provide each door with Component Hardware #M22-2420.

Doors - Sliding

Make same as specified for hinged doors, except they shall operate on Component Hardware #B58-5513 and #B58-5523 nylon tire wheels running on one (1) piece drawn aluminum overhead Component Hardware #B57 tracks. Bottom shall be guided by st. st. Component Hardware #B56-1096 guide pins at center of door openings. Provide locks where called for in item specifications. Provide flush type polished handles. (Heated cabinets with sliding doors to use Component Hardware #B58-5511 and #B58-5523 st. st. ball bearing wheels).

"High" type fixtures to be fitted with two (2) sets of doors in height, each set opening into half height of fixture.

"Low" type fixtures to be fitted with (1) set of full height doors. No door length to exceed 36".

Sinks

All sinks to be made of 14 ga. st. st. unless otherwise specified. All corners shall be coved at least 5/8" radius, with all corners and joints welded, ground and polished smooth to a #4 satin finish. Sinks, unless otherwise specified, shall not be less than 14" deep. The use of solder or separate filler pieces to obtain coved corners will not be acceptable. All sink bottoms are to be integrally pitched to insure complete drainage of sink to waste opening. Edges at table height to have exposed edges formed to match adjoining table. Edges adjacent to table to be welded to table with all welds ground and polished smooth.

Unless otherwise specified, all sinks to be provided with backsplash 12" high x 2-1/2" wide to allow for pipe space in rear. Flange over at ends, with top edge turned back 2-1/2" at 45 degree angle and down 1". Provide openings for combination swinging type water faucet for each compartment.

In sinks of two (2) or more compartments, furnish between each sink compartment a 3/4" wide full height portion integrally welded to sinks at front, back and bottom maintaining smooth 5/8" radius coved corners as described in preceding paragraph.

Front of multiple compartment sinks shall consist of st. st. apron same gauge as sinks having length same as overall length of sink bowls and same depth as bowls. This apron shall be "L" shaped and welded to or part of the top rim.

Design of apron front to be such that sinks shall have an appearance of a continuous one (1) piece front face of all overlapping joints and open spaces between sink compartments.

Each compartment to be furnished with Component Hardware rotary handle type drain, connected rear overflow, 6" tailpiece and faucet of make and model number as called for in Item Specifications. Also each sink to be furnished with 14 ga. st. waste handle bracket welded to underside of sink.

Tables & Tops - Height

All working tops to be 34" high from floor, unless otherwise stated under specific item.

Metal Tops

Unless otherwise specified in Item Specifications, metal tops to be 14 ga. st. st. reinforced and braced on underside by framework consisting of 1-1/2" x 1-1/2" x 3/16" angles and 1" x 3" x 3/16" channels, galvanized where concealed and st. st. where exposed.

Framework angles to run full length and width and with angle crossbrace on not over 2'-6" centers. Channel reinforcing to run full length of tops down center of top. All tops with sinks shall be integrally pitched towards same.

All joints of framework to be welded with weld re-metalized. Tops to be bolted to framework in a concealed manner with st. st. bolts similar to AN-COR-LOX cup nuts. All metal tops to appear as one piece with all field and shop joints reinforced and welded, ground smooth, and polished, also to be made of largest piece obtainable.

No short pieces of metal will be acceptable. St. st. tops to have a #4 satin finish and all tops of this metal to be full 1/2" cove at re-entrant corners, also where turned up in rear or in front, such as dishtables. Solder filled corners will not be acceptable.

Metal edges to be made as described below and/or shown on detail drawings. Top to have all edges turned down 1-3/4" then back 1/2" at a 70 degree angle all around with all corners welded, ground, and polished smooth with no cracks or openings showing. All exterior corners to be well rounded bullnosed in 1-1/4" radius.

Dishtables & Pot Washing Tables

All free edges to be turned up 2-3/4" then rolled to 1-5/8" x 180 degrees and furnished with apron edge front, as per Edge Detail Sheet. All exposed and exterior corners to be coved at 5/8" radius with all joints welded, ground, and polished smooth.

Where tables abut a wall or other tall equipment, extend back and/or ends up 12" then back 2-1/2" at 45 degrees and down 1" parallel to wall. Provide with end filler pieces and all welded surfaces ground and polished smooth.

The underside of Dish and Pot Washing tables to be reinforced with 1-1/2" x 1-1/2" x 3/16" st. st. angles and 1" x 3" st. st. channels. Angles to run full length of tops at both front and rear of tops with crossbrace front to back on 2'-6" centers. Channel bracing to run down center, full length of tops. Tops shall be integrally pitched to dishwasher and sinks.

Fastening Tops to Washers and Other Equipment

Where tops are shown adjacent to dish or glass washer, etc., ends are to be turned down 1-1/2" into fixture and bolted tightly to it with approved gaskets between body and turned down edges. Backsplashes to have edge against fixture turned out 1-1/2" and tightly fitted to it. Free edges to be neatly fitted to fixture corners to prevent water from dripping on floor. All tops to have integral pitch to drain towards dishwasher.

Dish & Pot Table Drainage

During installation of dish tables and dishwasher, FSEC shall water test all counter tops to make sure of proper pitch before final plumbing and electrical connections are made. All water on counter tops shall drain with no standing puddles allowed. Should the FSEC fail to pitch tables properly, he shall be responsible for disconnecting plumbing and electrical connections and re-adjust tables to insure proper pitch. FSEC shall also be responsible for re-connecting all service lines after tables have been re-aligned.

Pipe Stands

All equipment requiring pipe legs or stands to be provided with sufficient supports to carry superimposed load of 100 lbs. per sq. ft. Top to be fabricated of 16 ga. st. st. Tubing to be Component Hardware #A46-5288 complete leg assembly Model Number 2236HB, 1-5/8" O.D., with st. st. hex head bullet shaped feet as previously specified. All pipe stands to be braced with crossrails, Component Hardware #A46-4288, 1-5/8" st. st. pipe welded to legs approximately 10" above floor or braced by lower shelf as specified hereinafter. Provide Component Hardware #A18-0206 st. st. gussets as previously specified, welded to framework on underside of top.

In place of gussets, st. st. legs may be welded to st. st. channels 5" long which shall fit into channel crossbracing. Flange of both channels to be machine bolted together. Holes for bolts to be slotted for adjustment. Provide legs on not over 5'-0" centers and additional if required or requested.

All pipe legs or vertical members to be set back from table top on ends and on front and back sufficient distance to offset any interference with workers, columns, walls or other items. Where tops are welded to sinks, omit pipe legs supporting top at sink location.

Shelves Under Tables

Under tops which are mounted on pipe legs or stands, shelves under table to be fabricated of 16 ga. st. st. with all edges flanged down 1-1/2" or as otherwise noted in the Item Specifications. Shelves to fit tightly around contour of legs and welded from underside. Shelves to be made up from long lengths with all joints welded, ground, and polished smooth.

Short lengths will not be permitted. Reinforced, as required, to support load of 50 lbs. per sq. ft. All sharp edges, burrs, and corners to be ground smooth and removed and then be slightly rounded. All shelves in cabinet bases are to be angle reinforced.

Cabinet Bases

Exterior cabinet bases to be constructed of 18 ga. st. st. with front face, exposed ends, rear, and corners integrally exposed with all welds ground and polished smooth to form a one piece construction appearance.

St. st. exterior to be mounted over a 1-1/2" x 1-1/2" x 1/8" all welded galvanized iron angle frame. Where st. st. exterior meets angle framework at drawer, door or shelf openings, exterior shall be turned in 1-1/2" over angle framework inside of openings. All drawers and doors to be flush with cabinet face.

All cabinet base bottoms to be enclosed with 18 ga. galvanized iron panels. Interior shelves of cabinet base to be constructed of 16 ga. st. st. and be reinforced with 1-1/2" x 1-1/2" x 1/8" angles. Rear and ends of shelves to be turned up 2" with all interior corners coved to 5/8" radius.

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Drawers

Drawer front to be 3/4" thick double pan construction with 16 ga. st. st. telescoping rear panels. Joints to be sealed same as specified for double pan hinged doors. Drawer front fitted with recessed st. st. grip handle, Component Hardware #CAGP63-1012. Drawer to be furnished with 18 ga. galvanized iron bottom with openings in front to accommodate drawer. Provide with cylinder type lock when specified under Item Specifications or shown on elevation details.

Opening in front to have edges turned in to fit drawer front which will be flush when drawer is closed. Bottom of enclosure to be open with edges turned in 1" on all sides.

All corners on enclosure to be continuously welded, then polished and ground smooth. Exposed rivets or screws will not be acceptable. Component Hardware #S81-2020 Drawer insert to consist of removable die-stamped 18 ga. st. st. pan approximately 20" square x 5" deep. Top edges of drawer insert to be flanged out on all sides, not less than 1/2" for resting on drawer extension glides. All sharp edges and burrs to be removed from drawer flange.

Housing supports to be made of 12 ga. st. st. formed into angles welded to underside of metal tops or screwed to underside of wood tops and to extend full width of top with rear enclosure, where exposed. All welded items to be ground and polished smooth. Screws for wood tops to be st. st. countersunk. Drawer housings to slide on 14 ga. st. st. telescoping channels with st. st. rollers, Component Hardware #S52 series extension roller slides.

Drawers

This mechanism must be designed so that drawer will not tilt when fully opened. Provide with stop mechanism to prevent pulling the housing from slides but with suitable extension so it may be removed for cleaning.

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Tier of Drawers

To be two (2) or three (3) in number of same size as specified for above and entirely enclosed with 18 ga. st. st. same as specified under cabinet bases with openings for drawers with all joints flush welded, grounded, and polished smooth.

Single drawers under table tops to be one inch (1") back of edge of fixture. All draws shall have front flush with cabinet body.

Fasteners

Exposed screw or bolt heads will not be permitted on fixtures. Rivets, if specified, shall be countersunk flush. Rivets to be same material as they join. Butt joints made by riveting straps under seams and then filling with solder or caulking will not be permitted or accepted.

Name Plates

All buy-out equipment shall be furnished with a permanently affixed metal name plate listing manufacturer's name, model number, voltage, cycle, phase, horsepower, etc., in an easily readable location. Dealers, installers, fabricators or service agencies name plate stickers shall not be fastened to any item without the approval of the Architect or Consultant.

7. MATERIALS AND WORKMANSHIP

Unless otherwise specified, all material shall be new and of best quality, perfect, and without flaws and shall be delivered upon completion in an undamaged condition.

Stainless Steel

Shall be type 304 having a standard analysis of 18% chrome and 8% nickel. St. st. to be as manufactured by Republic Steel Company, "Endure", Allegheny Metal Company, Crucible Steel Company, "Rezistal" or approved equal. Gauge to be specified under Item Specifications and furnished with #4 satin finish, unless otherwise specified.

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Galvanized Iron

Shall be American Rolling Mills "Armco", Republic Steel, Inland Steel, "Tocan" or approved equal.

Pipe legs shall be Standard-Keil #2235HB, 16 ga. st. st. (0.65" thick), tubing furnished with st. st. adjustable foot and Standard-Keil #481-58 with enclosed gusset welded to underside of table top reinforcing channel.

Tubing to be seamless drawn, ground, and polished smooth to a #4 satin finish. Bottom of legs to be swedged for close fit to adjustable foot. Where space permits furnish 1-1/4" dia. st. st. crossrails welded to leg uprights. All welds shall have radius corners and be ground and polished smooth to a #4 satin finish.

Handles, Hinges & Door Fasteners

All hardware and other fittings used in connection with the equipment to be cast nickel bronze or st. st. Handles to be welded or bolted to the equipment in a concealed manner. Bolts to be st. st. and hinges to be recessed in door with st. st. Component Hardware #M75-1002 lift-off, N.S.F. approved hinge. Hinges to be fastened in place with st. st. recessed rivets or welded in place with weld ground and polished smooth.

Sliding doors to be depressed type and furnished with Component Hardware Model #P62-1010 handles. Hinges to be olive knuckle, semi concealed type of nickel bronze or st. st. piano type as described under the specific item.

Painting and Coating

All metal that is not st. st. is to be painted with two (2) coats of an approved rust-proof paint such as Rustoleum or other approved equal of highest quality gray enamel.

Electric Receptacles

All 120V-1 phase duplex receptacles in cabinet bases to be Pass & Seymour Model #6307 and receptacles over 120 volt shall be Hubbel receptacles sized as per the rough-in drawings.

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All receptacles are to be grounded type being both dust and moisture proof. Furnish outlets with st. st. face plates and neoprene mats. In cabinet bases, all receptacles are to be mounted in Chase #R-1 all coved corners st. st. recessed type enclosure mounted to cabinet base. Component Hardware #R73 - 1210 receptacles shall be pre-wired by FSEC to junction box in bottom of base cabinet left ready for final connection by Electrical Trades. All wiring between receptacles and junction box to be run in rigid conduit.

All counter top receptacles to be Component Hardware #R58 chrome plated type as specified in Item Specifications. Counter top receptacles to be pre-wired to junction box in rigid conduit same as previously specified. All wiring to be in strict compliance with latest standards of the National Sanitation Foundation and Board of Health Requirements.

Quietness of operation of all food service equipment is a requirement and the FSEC shall be required to remove or repair any equipment producing objectionable noises.

Shop Drawing Review

All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, Architect and Consultant. Submittals not bearing the FSEC's stamp will be rejected.

By reviewing and submitting shop drawings and samples, the FSEC thereby represents that he has verified all construction criteria, materials, catalog numbers and similar data and that he has checked and coordinated each shop drawing and sample with the requirements of the work and of the contract documents.

If shop drawings and/or samples are submitted without proper identification and in the Consultant's opinion it is evident that they have not been properly reviewed by the FSEC or if shop drawings are submitted in an unprofessional manner, they will be returned to the FSEC for identification and/or review and re-submission. In such an event, it will be held that the FSEC has not complied with the above requirements for reviewing and identifying shop drawings and samples. The FSEC shall bear the risk of all delays in work or in work of any other trade, the

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same as if no shop drawing or samples had been submitted. The above requirements will be strictly enforced.

The Consultant will review and process only two (2) submissions of each shop drawing and/or sample. Shop drawings and samples returned because the FSEC has not complied with the above requirements shall be counted as the first submission. If more than two (2) submissions are required, the FSEC shall pay the Consultant's cost for reviewing and processing the third and subsequent submissions. (Which will be so identified by the Consultant when returned to the FSEC)

The Consultant's cost shall be computed at two and one half (2-1/2) times payroll plus reproduction and mailing expense.

Buy-out Booklets

By submitting prepared Buy-out Booklets, the FSEC thereby represents that he has determined and verified voltage and phase requirements and that he has checked and coordinated each item with shop drawings and contract documents.

Each item in the Buy-out booklet shall have a typed title page, complete with descriptive details and included accessories.

TITLE PAGE TO BE AS PER THE FOLLOWING PAGE.

8. EXECUTION

Inspections

The Owner, Architect, and/or their duly authorized representative shall have free access to the contractor's shop or shops during the construction of this equipment for the purpose of making inspections to see that the plans and specifications and detailed drawings are being adhered to carefully.

Contractor shall correct any errors found during the inspections, to the extent within the scope of the plans, specifications and detailed drawings.

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Upon being notified of job completion, it shall be the responsibility of the Food Service Consultant to inspect the job site and prepare an itemized Punch List.

If items are found not to be complete per approved drawings, General Requirements and the Consultant's Item Specifications, upon receiving the Punch List, the FSEC shall correct all items on the list within thirty (30) days.

It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned rough-in drawings as prepared by the FSEC.

Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.

FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied.

SAMPLE TITLE PAGE

Food Service Equipment Contractor _____

ITEM # _____ QUANTITY _____

Description: _____

Electrical

Motor H.P. _____ Volts _____ Phase _____ Cycle _____

Heating Element: KW _____ Volts _____ Phase _____

Lighting and/or Fan Circuit: _____ Volts _____ Phase _____

Refrigeration specs.

Plumbing

Cold Water _____ 140 degree water _____ 180 degree water _____

Steam In _____ Steam Pressure _____ Pounds _____

Steam Return _____ Connected Waste _____ Floor Waste _____

Gas

Kind _____ Size _____ B.T.U. _____

Spec. Gravity _____ Pressure _____

Direction of Feed for Dishwasher

Right to Left, Left to Right, Straight Thru, Corner type, Clockwise, and Counter Clockwise (circle unit required).

Door Hinged

Right Side, Left side (Circle unit required).

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Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.

When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.

Rough-in Inspections

It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned rough-in drawings as prepared by the FSEC.

Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.

FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.

When deemed necessary by the Architect or the Consultant, the FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.

The FSEC shall check all base sizes, after installation by the Architectural Trades, to make sure that they will fit his equipment. Should base be installed incorrectly, the FSEC shall advise the Architectural Trades in writing at once to have base corrected as required.

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The FSEC shall check all walls where equipment abuts or fits between, after installation by the Architectural Trades, to make sure that the equipment will fit correctly.

9. PREPARATION

All gas equipment is to be furnished with appliance pressure regulators. Electrical requirements shall be in accordance with rough-in plan and verified on the job site.

Should the electrical requirements and the item specifications not agree with the rough-in plan or electrical requirements on the job site, it shall be the responsibility of the FSEC to send a written report to the Architect and Consultant advising them of the discrepancy. Should the FSEC fail to verify voltages on the job site, it shall be his full responsibility to make all necessary changes on his equipment at no cost to the Owner.

All measurements shall be verified at the building site and full responsibility for their correctness must be assumed by the Contractor.

No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on the drawings. All or any differences which may be found shall be submitted to the Architect for consideration before proceeding with the work.

10. INSTALLATION

Food Service Equipment

FSEC shall be responsible for assembly and erection of all equipment included herein and in required location as shown on drawings, leaving same with outlets for other contractors to make final steam, plumbing, electrical and ventilation connections.

FSEC is to provide a competent foreman to supervise the erection and placing of equipment and to advise other Trades in regards to connections at time of installation. Where applicable, he shall deliver to other Trades all plumbing, steam fittings, and electrical parts included with his equipment for their proper installation.

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FSEC to have qualified personnel on job site while the Plumbing, Electrical, and H.V.A.C. Trades are making final connections between rough-in and equipment. Where necessary, FSEC is to move equipment to allow these Trades to make final connections. Should the FSEC fail to assist the other Trades and final location of equipment is incorrect, it shall be the responsibility of the FSEC to move the equipment to correct location and assume the cost of disconnecting and reconnecting the service connections.

FSEC is responsible for cutting all holes thru tops, backsplashes, shelves and cabinets so the other Trades can make final connections to outlets in fixtures from his rough-in.

Should specified equipment arrive at the job site with incorrect finish, model number, damaged, etc. A replacement item must be ordered immediately. Should the project schedule require the incorrect unit for opening operation, existing unit is to be left in operation until replacement is available, at no cost to the owner. It shall be the responsibility of the FSEC to assume all costs for re-stocking, re-selling, etc., of the incorrect items that have been used by the Owner.

All holes or openings must be cut in a workmanlike manner, with all edges ground and polished smooth and free of sharp edges. Opening in rear of base cabinet must not be larger than 1" bigger than pipe extending thru cabinet. Oversize cutouts with rough edges will not be approved.

All faucets and waste assemblies to be furnished by the FSEC and to be turned over to the Plumbing Trades for their installation. NOTE! Faucets and waste assemblies to be tagged properly to insure proper installation of these items on the correct fixtures.

Ventilating Trades

This Trade will furnish all ductwork to openings on top hoods, furnished by the FSEC.

Electrical and Plumbing Trades

These Trades shall furnish all final electrical and plumbing connections between fixtures and rough-in outlets in walls or floors.

Internal connections on booster heater and disposer to be furnished by the Plumbing and Electrical Trades and proper installation of these above named items. FSEC shall also include detailed drawings showing proper location of all accessories. General Building Contractor shall furnish all masonry platforms, tile bases and floor depressions.

Trimming & Sealing Equipment

Space between units to walls, ceilings, and floors and adjoining units not portable and with enclosed bodies, shall be completely sealed against entrance of food particles or vermin by means of st. st. trim strips, welding or commercial joint material suitable to the nature of the equipment. Sealer when not exposed to extreme heat shall be silicone construction sealant in the appropriate color. Ends of hollow sections to be closed. Enclosed fixtures without legs mounted on masonry bases or floor shall be sealed watertight to base of floor.

All equipment setting on masonry bases will be constructed to overhang to provide toe spaces, however, metal framework and/or housings are to be turned under a sufficient distance to overlap masonry base and eliminate openings at these points. Bases to be sealed with Dow Corning sealant #786 or approved G.E. sealant.

11. ADJUST & CLEAN

FSEC shall adjust and lubricate all moving parts for smooth quiet operation. The FSEC shall touch up scratches, marred or abraded surfaces to restore equipment to the original condition.

The FSEC shall also remove all crating and packing material from the job site and shall also remove fingerprints and leave equipment and adjacent equipment or surfaces clean.

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The FSEC shall be responsible for missing items unless he can produce signed receipts from the Owner's personnel that the items were received and an accounted for. Owner cannot be responsible for items that were dropped off at the job site and were not signed for by the Owner's personnel or representatives.

12. DEMONSTRATION

The FSEC shall arrange a demonstration date with the Owner and at the same time check out all loose items with the Food Service Manager. Copy of signed receipts shall be mailed to E. F. WHITNEY, INC., showing all loose items, such as st. st. pans, mixer attachments, etc.

13. GUARANTEE

All items furnished by the Food Service Equipment Contractor as part of this Contract, shall be guaranteed against defects in workmanship and material for a period of one (1) year.

Manufacturers of standard items of equipment as supplied under this Contract are to provide a one (1) year warranty on parts and labor.

In addition, connected pieces of equipment requiring calibration are to be so calibrated by a qualified person as part of this Contract.

Commencement date for warranty purposes is as follows:

- a. Connected equipment: - When equipment is started up for intended use."
- b. Non-connected equipment: - At date of Owner acceptance."

14. PROTECTION OF EQUIPMENT

Fabricated fixtures such as custom st. st. & plastic laminate items are to have fiberboard or plywood taped to tops and exposed body panels. Protective covering is to be left in place until all trades are completed.

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Manufactured equipment is to have fiberboard or plywood tape as required per equipment shape and installation access requirements.

Prohibited use of equipment; tool and material storage area, workbench, scaffold, stacking area, etc.

15. APPROVED CUSTOM ST. ST. FABRICATORS

The following is a list of fabricators who have demonstrated the ability to provide quality equipment.

Florida Stainless
Oviedo, FL

American Stainless Steel Corp.
Englewood, CO.

PRS
Warren, MI

Great Lakes Stainless
Traverse City, MI

American Foodservice
Savannah, TN

MCM Fixture Co.
Hazel Park, MI

Midwest Stainless Fabricating Co.
Livonia, MI

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ITEM #1 REACH IN FREEZER

One (1) Unit provided by Owner. "NIC"

ITEM #2 REACH IN REFRIGERATOR

One (1) Unit provided by Owner. "NIC"

ITEM #3 REACH IN REFRIGERATOR

One (1) Unit provided by Owner. "NIC"

ITEM #4 12 QT. MIXER

One (1) Unit provided by Owner. "NIC"

ITEM #5 ST. ST. TABLE W/ SINK & OVERSHELF

One (1) Custom fabricated unit, sized 10' - 0" long x 5' - 0" wide x 34" high.

TOP: Fabricated of 14 gauge stainless steel with type "A" edges on all open sides. Top to have bullnosed corners with No. 4 finish and reinforcing angles/channels under, per General Requirements.

SINK: Per plan furnish two (2) integrally welded sink 18" x 21" x 12" deep. Sink fabricated of 14 ga. st. st. with horizontal and vertical corners with not less than 5/8" integral radius. Sink bottom to be pitched to drain towards 3-1/2" dia., die stamped opening. Sink to be polished out in all corners to a #4 finish.

SINK TRIM: One (1) Fisher Model #3311-EFW deck type faucet furnished with #3961, 12" swing spout with #3000-8000 aerator. Faucet caulked watertight to counter top. Faucet to be cast red brass, all chrome plated with color coded hot and cold water faucets.

One (1) Fisher 1-1/2" I.P.S. twist handle drain with connected rear overflow assembly with s t. st. tailpiece 6" long.

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NOTE! FSEC and counter fabricator to coordinate faucet spout to allow both sinks to be reached.

ELECTRICAL: Per rough-in plan furnish recessed duplex receptacles for undercounter refrigerators. Receptacle to be all pre wired in approved conduit per electrical code to junction box ready for final connection by Electrical Trades. Junction box to be located below shelf. See electrical plan for outlet locations.

Receptacle to be duplex unit Pass & Seymour model #6307 set in Standard-Keil #2773 stainless steel recessed receptacle holder. Include Pass & Seymour neoprene mat gasket and stainless steel faceplate. Receptacle to be three (3) prong grounded type installed to meet all safety and electrical codes.

SHELF UNDER - Under top as shown on plan or elevation, furnish 16 gauge stainless steel removable shelf. Shelf to be rolled over crossrails in front and sides. Rear to be turned up 3" against walls or side equipment. Shelf to have all coved corners at not less than 5/8" radius. Omit crossrail and undershelf under clean dishtable for dish cart storage.

SHELF OVER - Provide st. st. overshelf as shown on plan and elevations. Shelf to be provided with turn down edges.

DRAWER - Under top as shown on plan furnish 18 gauge stainless steel drawers 20" x 20" x 5" deep. Drawer insert to be removable type with roller bearing extension slides, double pan construction drawer front and 18 gauge stainless steel cabinet enclosure constructed per General Requirements. Drawer to be furnished with cylinder lock installed per manufacturer's recommendations. All drawer locks to be keyed alike on entire job.

REFRIGERATOR - Provide open space under top between legs to accommodate undercounter reach in refrigerator. Unit to be shipped to counter fabricator to insure proper fit and electrical connection.

OPEN STORAGE - Provide open storage under top as shown on plan for ingredient bin storage.

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LEGS - Counter to be supported on st. st. legs with flange feet. FSEC to secure flange feet to floor with heavy duty st. st. lag screws.

Submit shop drawing for review and approval.

ITEM #6 UNDERCOUNTER REFRIGERATOR

One (1) TRUE model #TUC-48 LP (Energy Star ®) two compartment undercounter refrigerator. Unit to be sized 48" wide x 32" high. Unit to be furnished per manufacturers standards. Include the following standard and optional accessories:

One (1) Lot LP casters
One (1) Cord and plug
One (1) Exterior thermometer
One (1) Additional interior shelf
One (1) Lot Door Locks

Unit to be turned over to counter fabricator to insure proper

ITEM #7 DOUBLE DECK CONVECTION OVEN

One (1) Unit provided by Owner. "NIC"

ITEM #8 24" WIDE FOUR BURNER RANGE

One (1) Unit provided by Owner. "NIC"

ITEM #9 TILT BRAISING PAN W. STAND

One (1) Unit provided by Owner. "NIC"

ITEM #10 ST. ST. EXHAUST HOOD

One (1) CAPTIVEAIRE model #6024ND-2 exhaust only canopy rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings. Construction shall be type 430 stainless steel with a #4 polish where exposed. Individual component construction shall be determined by the manufacturer, ETL, and NSF. Construction shall be dependent on the structural application to minimize distortion and other defects. All seams, joints and penetrations of the

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hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. Hood shall be wall type with a minimum of four connections for hanger rods. Connectors shall have 9/16" holes pre-punched in 1 1/2" x 1 1/2" angle iron at the factory to allow for hanger rod connection by FSEC.

Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.

The hood manufacturer shall supply complete computer generated submittal drawings including hood sections view and hood plan view. These drawings must be available to the engineer, architect and owner for their use in construction, operation and maintenance.

Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.

The hood shall have:

A double wall insulated front to eliminate condensation and increase rigidity. The insulation shall have a flexural modulus of 475 EL, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.

An integral front baffle to direct grease laden vapors toward the exhaust filter bank.

Removable grease cup for easy cleaning.

The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", NSF Listed and built in accordance with NFPA 96. The hood shall be listed for 450°F cooking surfaces at 150 CFM/ft, 600°F cooking surfaces at 200 CFM/ft, and 700°F cooking surfaces

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at 250 CFM/ft. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper".

Accessories to be included:

One (1) Lot Heat Sensors and Controls per code.
One (1) Lot UL Incandescent Lights
One (1) St. St. Quarter End Panels
One (1) Lot Stainless filters Captrate Solo filter with hook,
ETL Listed. Particulate capture efficiency: 93% efficient at 9
microns, 72% efficient at 5 microns
One (1) Lot Field Wrapper Panels

Submit shop drawing for review.

ITEM #11 FIRE SYSTEM

One (1) system completely installed ANSUL R102 Wet Chemical Restaurant Kitchen Fire Suppression System sized to meet job requirements in accordance with the manufacturer's specifications and installed only by an authorized Ansul Pre-Engineered Restaurant Fire System Distributor. This system must be installed in accordance with UL-300, BOCA, NFPA-17A, NFPA-96 and the authority having jurisdiction. The ANSUL R102 installing company must carry complete Operations Liability Insurance of a minimum of \$1,000,000.

NOTE! Units MUST BE INSTALLED IN the ANSUL R102 factory stainless steel ENCLOSURES. Any Fire System not completely installed in an authorized cabinet must be approved by the Food Service Equipment Consultant in writing prior to such substitution. Cabinet installation must comply with CABO/ANSI A117.1-1992.

NOTE! Mechanical Gas Valves must be used for automatic shut-off. Any Fire System installed using an Electric Gas Valve must have written approval from the Food Service Equipment Consultant prior to such installation.

System to provide automatic fire suppression for the plenum area of Exhaust Hood, connecting exhaust ducts.

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STANDARD: All equipment and the complete system shall conform to NFPA #96, vapor removal from cooking equipment Underwriters Laboratories File #EX2458.

APPROVALS: All devices furnished shall be constructed and installed in accordance with this specification and shall be U.L. approved.

MATERIAL: Exhaust Hood, Duct, and Cooking Appliance Fire Suppression shall be ANSUL R102.

INSTALLATION: System shall be installed in conformance with the latest edition of applicable standard of NFPA 17A, NFPA 96, BOCA, Manufacturer's manual and all applicable state and local codes.

1. Installer shall visit the job site, take all field measurements and verify all conditions affecting the work unless shown on attached plan.
2. Obtain and pay for any permits specifically required for the fire suppression installation.
3. Provide shop drawings showing the piping and mechanical detail of the fire system to the authority having jurisdiction.

TEST: Upon completion of installation, seller to perform all tests necessary to fulfill requirement of the authority having jurisdiction.

SPECIFIC JOB SITE REQUIREMENTS: System to be provided with Two (2) Micro switches (DPDT) mounted in the ANSUL R102 control cabinet. Second switch to be interfaced with the building Fire Alarm, if required.

System installer to provide a manual reset relay to the Electrical Contractor for installation into the fuel shut-off system.

The installer to provide the Plumbing Contractor one mechanically operated automatic gas shut-off valve, for each fire suppression system, sized for the job requirements. Plumber

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is to install the valve. System installer is to connect the gas valve cable to the ANSUL R102 control cabinet.

The ANSUL R102 System must be located where shown on the food service equipment drawings.

NOTE! ANY RELOCATION of the ANSUL R102 System MUST BE APPROVED by the Food Service Equipment Consultant in writing prior to such relocation.

The ANSUL R102 Fire System installer shall be responsible for cutting or punching holes in walls, ceilings and floors for installation of the equipment. The installer will be responsible for furnishing trim flanges or patching and painting of any holes required for the installation of the ANSUL R102 System.

PIPING: Fire System to be per ANSUL R102 standards. All piping and conduit of the ANSUL R102 is to be concealed where possible and all piping and conduit to be either chrome plated, chrome sleeved or stainless steel where exposure is necessary.

PLUMBING CONTRACTORS RESPONSIBILITIES: The Plumbing Contractor shall be responsible for the installation of the automatic gas shut-off valve required for the automatic shut-off of the gas supply to all gas operated appliances under Exhaust Hood.

The valve shall be installed as near as possible to the subject cooking equipment and should not be installed in a location that would affect the shutdown of the gas supply to any gas operated equipment not located under the Exhaust Hood. The mechanical gas shut-off valve required under this specification shall be furnished to the Plumbing Contractor by the ANSUL R102 System installing company.

ELECTRICAL CONTRACTOR'S RESPONSIBILITIES: The Electrical Contractor shall be responsible for all labor and materials required to completely connect the cooking fuel shut-off system.

The Electrical Contractor shall be responsible for installing a ½" conduit and flush-mounted standard 4" X 4" electrical octagon box with screws at 2 & 8 o'clock for each ANSUL R102 system. Verify height requirement with Authority Having Jurisdiction.

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This is to be used for the manual pull station to activate the Fire System. The ½" conduit should extend approximately 15" above the finished ceiling.

The following must be completed by the Electrical Contractor (See electrical rough-in plan for details):

1. All electrical under the Exhaust Hood must shut down upon activation of the ANSUL R102 Fire System. This includes all outlets, hard-piped appliances and all refrigeration stands.
2. All Make-up Air Units for the Exhaust Hoods in the kitchen must shut down.
3. Exhaust Hood Fans must continue to run.
4. If an electrical gas valve is used, a manual reset relay must be used. This relay is to be supplied by the ANSUL R102 installer.
5. If Fire Alarm notification is required, one of the micro switches is to be used for this purpose.
6. No electrical connections to be made inside the ANSUL R102 control cabinet.

ITEM #12 ST. ST. WALL PANELING

One (1) Lot of 18 ga. Stainless steel rear and side wall paneling sized per plan and elevation detail. Provide wall panels from bottom edge of hood down to top of base cove. Verify height of cover before fabrication. Provide panels with finish to match hood and in lengths to match hood(s) section(s) wherever possible. Panels to butt together with hairline joint and be installed with concealed fasteners.

FSEC to provide all necessary cut outs for utility lines.

Submit shop drawing for review and approval.

ITEM #13 ICE MAKER W/ BIN

One (1) Unit provided by Owner. "NIC"

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ITEM #14 ST. ST. HAND SINK

QTY: One (1)

MFG. & MODEL: ADVANCE #7-PS-51

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 1301 TMV or equal ADVANCE electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

Provide st. st. splash shield on Left hand side.

ITEM #15 ST. ST. WORK COUNTER W/ OVERSHELVES

One (1) Custom fabricated unit sized approx., 10' - 0" long x 30" deep per plan x 34" high to working surface per plan and elevation detail.

TOP

Fabricated of 14 ga. st. st. with front and exposed end furnished with type "A" turned down edges.

BACKSPLASH

Sides where shown on plan, against walls to be furnished with 6" high integral backsplash. Exposed ends to be finished.

FSEC to coordinate roll down gate tracks with side splash in insure proper clearance.

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LEG SUPPORTS

Top to be mounted on EFW all stainless steel one (1) leg support. Gusset, leg, crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

SHELF OVER

Over top as shown on plan furnish single deck 16 ga. st. st. shelf with 1.5" turned down edge on front and rear. sides. Shelf to be mounted on 1-1/4" dia., st. st. uprights extending up thru top Holes in top to be cut out to fit upright with not more than 1/16" clearance, then caulked with clear silicone sealant.

FSEC to coordinate shelf location with roll down closure track to insure clearance.

SHELF UNDER

Under top, per plan or elevation, furnish 16 gauge stainless steel removable shelves. Shelves to be rolled over crossrails in front and sides. Rear to be turned up 3" against walls or side equipment. Shelves to be all coved cornered fabricated at not less than 5/8" radius.

SHOP DRAWING

Submit shop drawing for review and approval.

ITEM #16 PORTABLE PAN RACK

One (1) Unit provided by Owner. "NIC"

ITEM #17 ST. ST. THREE COMPARTMENT SINK

One (1) ADVANCE TABCO model #93-3-54-24RL three compartment sink furnished per manufacturers standards. Unit to be sized 103" long x 26.5" deep overall. Sink to be furnished with the following:

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SINK TRIM: Three (3) compartment unit to be furnished with the following:

One (1) FISHER #5412 (3/4" I.P.S.) 12" Swing Spout Faucets, Aerators, and #LL Street Els to fit in rear of Backsplash to accommodate 3/4" water lines.

Furnish each faucet complete with FISHER Model #2200-0000 Assembly to facilitate fastening to Backsplash

Three (3) FISHER Model #6301 (2" I.P.S.) Twist Handle Drains with removable basket strainers, connected rear overflow and #6129 Tailpiece Assembly. Twist Handle Drains furnished with 14 ga. st. st. bracket welded to underside of sink.

Sink trim to be furnished with identification tags and signed over to Plumbing Trades for their internal and final connections to rough-in locations.

NOTE! FSEC to coordinate spout length to insure unit reaches all three sink compartments.

ITEM #18 ST. ST. HAND SINK

QTY: One (1)

MFG. & MODEL: ADVANCE #7-PS-51

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 1301 TMV or equal ADVANCE electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

Provide st. st. splash shield on Right hand side.

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ITEM #19 ST. ST. SOILED & CLEAN DISHTABLES

One (1) Custom fabricated unit size and shape as per plan with integral pitch to allow tables to drain towards dishwasher, scrap collector and table drainer.

TOP

Fabricated of 14 gauge stainless steel with front and exposed ends furnished with type "F" semi rolled rim edge. Working surface to have integral pitch to drain surface area of any excess water. Top of rim to be parallel with floor. Reinforcing under and polish to be furnished in accordance with General Requirements and standard edge details.

BACKSPLASH

Rear and sides where shown on plan, against walls or equipment to be furnished with 12" high integral backsplash. Top to be turned back at 45 degree angle with 1" return down parallel to wall. Furnish 14 gauge stainless steel "Z" clips to hold backsplash tight to wall in neat and workmanlike manner. Provide clear silicone sealant to wall and equipment per Board of Health Requirements. See Edge Detail type "G" for construction requirements.

LEG SUPPORTS AGAINST WALL

Top and sink to be mounted on EFW all stainless steel one (1) leg support. Gusset, leg crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

SHELF UNDER

Under top as shown on plan or elevation, furnish 16 gauge stainless steel removable shelf. Shelf to be rolled over crossrails in front and sides. Rear to be turned up 3" against walls or side equipment. Shelf to have all coved corners at not less than 5/8" radius.

DISPOSER CUTOUTS

Where shown, top to be cut out to accommodate disposer cone specified under separate item. Cone to be continuously welded around full perimeter, then ground and polished smooth to a #4 satin finish. Under top furnish 14 ga. Stainless Steel bracket to accommodate disposer control panel or switch. Rear backsplash to be punched out to accommodate vacuum breaker assembly specified under disposers item #25.

TABLE DRAINER

In top of soiled table, where shown on plan, furnish integrally welded table drainer 6" wide x 3" deep x full width of dishtable. (Full width to mean from front vertical inside edge of rolled rim to back of vertical edge of backsplash). Inside edges both horizontally and vertically furnished with not less than 1/2" radius. Interior of drainer to be furnished with all coved cornered perforated strainer basket made of 16 gauge stainless steel.

Include 1/4" stainless steel rod guide handles to allow racks to slide over drainer area. Drainer pitched to drain and to have die-stamped opening and furnished with Fisher or Standard-Keil basket drain, brass chrome plated with 1-1/2" tailpiece.

Provide basket drain in bottom of soiled table as shown on plan.

RACKING SHELF WITH STORAGE OVER

One (1) unit approx 6'- 0" long constructed of 14 ga. Stainless Steel and mounted over soiled dishtable. Shelf to be constructed deep enough to hold a 20" x 20" rack in a slanted position within easy reach of operator. (Verify largest dish rack size & ceiling height).

Underside of shelf to be reinforced with 12 ga. Stainless Steel channels and be supported from dishtable by 1-5/8" dia. Stainless Steel tubular uprights. Uprights to have 12 ga. Stainless Steel welded cantilever brackets and be rigidly reinforced to underside of dishtable.

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Shelf to be furnished with "V" shaped integrally welded and pitched drain troughs. End of troughs to be furnished with clear plastic 1" dia. drain hose, extending down to dishtable.

Open ends of shelf to be welded closed. Furnish center support up to structure above with all 1-5/8" Stainless Steel uprights. Install flange at ceiling.

Over top racking shelf, furnish a rack storage shelf constructed of 1-1/4" dia. Stainless Steel all welded tubular stock as shown on section detail. Storage shelf to be supported by 1-5/8" dia., Stainless Steel uprights. UPRIGHTS TO HAVE SMOOTH RADIUS BENDS, 90° ANGLES WILL NOT BE ACCEPTABLE.

See elevation for additional construction information.

DISH RETURN TRAY REST

Where shown on plan, furnish 8" wide sloped dish return sill. See section for exact details.

Submit shop drawing including column for review.

ITEM #20 WIRE WALL SHELVING

One (1) Lot Metro Chrome wire wall shelving sized per plan. Unit to consist of two (2) 14" deep chrome shelves with two (2) 2WD14C chrome wire wall supports Each chrome wire wall support consists of one shelf support and mount plate with two caps. FSEC to mount wire shelf supports to wall with heavy duty SST lag bolts.

ITEM #21 ST. ST. WALL PANELING

One (1) Lot of Custom Fabricated 18 ga. st. st. rear and side wall paneling 30" high by length and width as shown on plan. Furnish paneling hair line butt joints. Paneling to be sealed on sides and top with clear silicone sealant.

Panel section behind dishwasher to run from bottom edge of condensate hood down to top of coved tile base. FSEC to provide necessary cut outs for power and water supply lines.

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FSEC and St. St. Fabricator to verify window sill height and details to insure proper fit and wrap around as needed to cover walls and returns.

Submit shop drawing for review and approval.

ITEM #22 CORNER CHEMICAL RINSE DISHWASHER

One (1) Unit provided by Owner. "NIC"

ITEM #23 ST. ST. CONDENSATE HOOD

One (1) CAPTIVEAIRE model #4824VHB-G 24" high dishwasher hood. Hood to have a dimension of 6'- 8" from bottom edge of gutter down to floor line.

Unit to be fabricated of 18 ga. st. st. all welded construction of box type design. Bottom edge to be furnished with 1-1/2" wide 18 ga. st. st. gutter. Inside edge of gutter to be slanted at 60° angle. All welds to be ground and polished smooth to match original finish.

Interior to be furnished with NSF approved LED fixture. Mount on interior top of hood and furnish wiring to "J" box ready for final connection by electrical contractor. All wiring to be installed in conduit in accordance with local and state electrical codes.

Top of hood to be furnished with 12 ga. st. st. channel supports to accommodate 1/2" dia., st. st. hanger rods, fastened to angle supports above suspended ceiling. Angle supports or inserts in slab above to be furnished and installed by FSEC. Condensate gutter to be furnished with 1/2" dia., grey CPVC drain tube from gutter to extend down to top of backsplash on soiled dishtable. Tube to be secured with st. st. wall bracket.

At top of hood at ceiling, furnish 18 ga. st. st. trim angles with feathered edges and welded mitered corners. Size of trim angles to be designed to suit field conditions. Inside of hood to be furnished with cutout to accommodate exhaust duct furnished by HVAC contractor. Furnish opening with 2" x 2" x 18 ga. st. st. trim collar with feathered edges and welded mitered corners.

Submit shop drawing for review.

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ITEM #24 SOAP AND RINSE SYSTEM

One (1) Unit provided by Owner. "NIC"

ITEM #25 3 H.P. DISPOSER W./ SPRAY

QTY: One (1) Lot

MFG/MODEL: IN-SINK-ERATOR SS-300-18B-CC101

CONSTRUCTION: Unit shall be a commercial, heavy-duty disposer with three (3) horsepower motor, stainless steel and chrome plated finish. Control Panel shall be 18 gauge Stainless Steel NEMA 4, waterproof enclosure.

ACCESSORIES:

One (1) 18" cone w/ two fixed nozzles
One (1) Stainless Steel Removable Cover and Scrap Block
One (1) Automatic Reversing Feature
One (1) Time Delay Relay set for 30 seconds
One (1) 24 volt line voltage transformer, controls operate on 24 volts
One (1) Line Disconnect Switch, Interlocks with front cover
One (1) Start/Stop Push Button
One (1) Flow control valve, and solenoid
One (1) Stainless Steel support leg
One (1) 14 gauge Stainless Steel mounting bracket
One (1) FISHER #2210 Spray Unit w/ #2955 spray valve w/ built in vacuum breaker
One (1) FISHER #3990 Vacuum Breaker Assembly w/ chrome plated pipe extension & elbows above backsplash area

DETAILS: Cone to be continuously welded to top with all welds ground and polished smooth. Control panel bracket welded to underside to top and set back so disconnect handle does not project beyond edge of table. Backsplash to be pre-drilled on exact centers to accommodate FISHER Vacuum Breaker Assembly #3990. FSEC shall tag all accessories with item numbers and locations of equipment. Accessories are then to be delivered to Plumbing and Electrical Contractors for their internal and final connections. FSEC shall furnish detailed drawings showing proper installation of loose accessories and piping details.

DETAILS: 3 H.P. (Voltage & Phase per rough-in)

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ITEM #26 OVERHEAD RACKING SHELF

One (1) Unit included with item #19.

ITEM #27 STATIONARY DRY STORAGE SHELVING

QTY: One (1) Lot arranged per plan.

MFG/MODEL: InterMetro Industries Corp Super Brite Super Erecta Shelving .

CONST:

All carbon steel construction. Shelves to have 10 ga. mat wires spaced 21/32" apart. Mat wires to be supported by 6 ga. support wire. Support wire spacing specific to shelf size. Shelf width greater than 18" include one to two 7 ga. snake wire supports running the length of the shelf. Shelf frame to be made up of 7 ga. snake wire with two 6 ga. snake support wire. A round 1 1/2" steel collar is welded at each corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. Round tubes notched every 1" of the post. A polypropylene post cap will be installed on the top of each post.

Finish will be Super Brite, a zinc based chromate bath.

ACCESSORIES:

The bottom of the post to have adjustable foot.

DETAILS:

Each shelving to be furnished five (5) tiers high with four (4) 84" high posts. Shelving size and quantity to be sized per plan. Shared uprights will not be accepted.

ITEM #28 CHEMICAL STORAGE SHELVING

One (1) Unit sized per plan. Shelving to be same as item #27.

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ITEM #29 ST. ST. WALL PANELS

Two (2) Custom fabricated 18 ga. st. st. wall panel sized full width of sink x 36" high. Panels to be secured to wall with hidden fastener. Edges to be sealed with silicone. FSEC to provided holes in panel as required to accommodate faucet.

Submit shop drawing for review and approval.

ITEM #30 WALL MOUNTED MOP RACK

One (1) Unit provided by Owner. "NIC"

ITEM #31 NOT USED

ITEM #32 MICROWAVE OVEN

One (1) Unit provided by Owner. "NIC"

ITEM #33 POS SYSTEM

One (1) Unit provided by Owner. "NIC"

ITEM #34 PORTABLE MILLWORK SERVICE STATION

One (1) Unit provided by Owner. "NIC"

ITEM #35 COFFEE MAKER

One (1) Unit provided by Owner. "NIC"

ITEM #36 PORTABLE MILLWORK CASHIERS STATION

One (1) Unit provided by Owner. "NIC"

ITEM #37 NOT USED

ITEM #38 FIELD ERECTION LABOR

FSEC shall deliver, unload, uncrate, and install all items herein specified ready for final plumbing, electrical and ventilation connections furnished by respective trades as outlined in the General Requirements.

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All equipment shall be cleaned and polished before demonstrating equipment to the Owner. All crating and packing material to be removed from job site.

FSEC shall arrange demonstration date with Owner and at the same time check out all loose items with the Food Service Manager.

FSEC shall be responsible for missing items unless he can produce signed receipts from Owner's personnel that the items were received and accounted for. Owner cannot be responsible for items delivered to the job site that were dropped off without being signed for by Owner's personnel or representatives.

Rough-in plans to be submitted at a scale of 1/4" = 1'-0". When present equipment is re-used at new locations, it shall be the FSEC'S responsibility to show necessary rough-in requirements for these items. (See General Requirements for complete details relating to submission of shop drawings). Two (2) Buyout Books to be sent to EFW for review and approval. Additional copies for use in field etc., to be made up as required after being check by EFW.

Two (2) complete sets of all final shop drawings, instructions, and parts lists are to be turned over to the Owner secured in a binder. This booklet shall include the telephone number and address of the service company for each piece of equipment.

NOTE! FSEC shall pay all sales, consumer, use and other similar taxes for the work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective.

Final payment cannot be recommended until all of the above items have been completed to our satisfaction.

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ITEMIZED PROPOSAL FORM
Rising Stars Academy
Center Line, MI

NAME OF
BIDDER: _____

ADDRESS: _____

DATE: _____ TELEPHONE NO _____

BASE BID

If this Proposal is accepted in writing within thirty (30) days from the date of the bid opening, undersigned having familiarized themselves with the drawings and specifications as prepared by E. F. WHITNEY, INC., agrees to enter into a Contract for furnishing all labor, materials, and facilities for Food Service Equipment in connection with the above named project for the total base bid sum amount of \$ _____ including sales tax.

(\$ _____ DOLLARS)

The amount shown shall be shown both words and figures. In case of a discrepancy, the amount shown in words shall govern. Sales tax amount must be shown.

TIME OF COMPLETION

The Bidder agrees to complete the above-named project in _____ consecutive calendar days.

BID GUARANTEE

TYPE: _____

AMOUNT \$ _____

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CONTRACT ASSUMPTIONS

The Bidder agrees to enter into a sub-contract with the General Construction Work Contractor, (Architectural Trades) as designated by the Owner. The sub-contract shall be based upon the prices, terms, and conditions set forth in the Proposal.

ADDENDA

Proposal is based on the following Addenda:

Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

SIGNATURE

Signed By: _____

Dated and signed
at: _____

State of _____ this _____ day of _____, 2013

LEGAL STATUS OF BIDDER

A Corporation duly organized and doing business under the laws of the State of _____ for whom _____ whose signature is affixed to this Proposal is duly authorized to execute contracts.

A Partnership, all members:

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An individual whose signature is affixed to this Proposal:

INSTRUCTIONS

The Base Bid must be on fixtures specified for a fair comparison of all the bids. Prices on alternate equipment will be accepted on a separate sheet made up by the Bidder with illustrations and alternate specifications.

The following pages contain a schedule of the various items of equipment. All manufacturers names and other data requested must be filled in by the Bidder.

ON FABRICATED ITEMS, PLEASE GIVE THE NAME OF YOUR FABRICATOR

ITEM NUMBER	DESCRIPTION	QUANTITY	MANUFACTURER'S OR FABRICATOR'S NAME AND MODEL NUMBER	PRICE
1	Reach In Freezer	_____	_____	_____
2	Reach In Refrigerator	_____	_____	_____
3	Reach In Refrigerator	_____	_____	_____
4	12 Qt. Mixer	_____	_____	_____
5	St. St. Table W/ Sink	_____	_____	_____
6	Undercounter Refrigerator	_____	_____	_____
7	Double Deck Con Oven	_____	_____	_____
8	24" Four Burner Range	_____	_____	_____
9	Tilt Braising Pan/Stand	_____	_____	_____

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10	St. St. Exhaust Hood	_____	_____	_____
11	Fire System	_____	_____	_____
12	St. St. Wall Paneling	_____	_____	_____
13	Ice Maker W/ Bin	_____	_____	_____
14	St. St. Hand Sink	_____	_____	_____
15	St. St. Work Counter	_____	_____	_____
16	Portable Pan Rack	_____	_____	_____
17	St. St. Three Comp Sink	_____	_____	_____
18	St. St. Hand Sink	_____	_____	_____
19	Soiled/Clean Dishtables	_____	_____	_____
20	Wire Wall Shelving	_____	_____	_____
21	St. St. Wall Paneling	_____	_____	_____
22	Chemical Dishwasher	_____	_____	_____
23	St. St. Condensate Hood	_____	_____	_____
24	Soap And Rinse System	_____	_____	_____
25	3 HP Disposer W./ Spray	_____	_____	_____
26	Overhead Racking Shelf	_____	_____	_____
27	Dry Storage Shelving	_____	_____	_____
28	Chemical Storage Shelving	_____	_____	_____
29	St. St. Wall Panels	_____	_____	_____
30	Wall Mounted Mop Rack	_____	_____	_____
31	Not Used	_____	_____	_____
32	Microwave Oven	_____	_____	_____
33	Pos System	_____	_____	_____
34	Millwork Service Station	_____	_____	_____
35	Coffee Maker	_____	_____	_____

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36 Millwork Cashiers Station	_____	_____	_____
37 Not Used			
38 Field Erection Labor	_____	_____	_____
		6% Sales Tax	_____
		TOTAL BASE BID	_____

SECTION 15010 - MECHANICAL GENERAL REQUIREMENTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.

1.2 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

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.
1. AABC - Associated Air Balance Council.
 2. ABMA - American Bearing Manufacturers Association.
 3. ABMA - American Boiler Manufacturers Association.
 4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The).
 5. AMCA - Air Movement and Control Association International, Inc.
 6. ANSI - American National Standards Institute.
 7. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.
 8. ASTM - American Society for Testing Materials.
 9. CDA - Copper Development Association.
 10. CGA - Compressed Gas Association.
 11. CSA - CSA International.
 12. HI - Hydraulic Institute.
 13. Intertek - Intertek Group.
 14. NAIMA - North American Insulation Manufacturers Association.
 15. NEBB - National Environmental Balancing Bureau.
 16. NEC - National Electrical Code.
 17. NECA - National Electrical Contractors Association.
 18. NEMA - National Electrical Manufacturer's Association.
 19. NFPA - National Fire Protection Association.
 20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
 21. UL - Underwriter's Laboratories, Inc.
- 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.

2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.
- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- D. Refer to Division 15 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.7 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. 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 with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but

not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 SUBMITTALS

- A. Submit project specific submittals for review in compliance with Division 01.
- B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".

- E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
- F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
1. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 2. Contractor is responsible for:
 - a. Dimensions, which shall be confirmed and correlated at the job site.
 - b. Fabrication processes and techniques of construction.
 - c. Quantities.
 - d. Coordination of Contractor's work with all other trades.
 - e. Satisfactory performance of Contractor's work.
- G. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

1.12 COORDINATION DRAWINGS

- A. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

- B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
- C. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- D. Operation and maintenance instructional manuals shall be submitted a minimum of four (4) weeks prior to functional testing.
- E. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
1. Routine maintenance procedures.
 2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 3. Trouble-shooting procedures.
 4. Contractor's telephone numbers for warranty repair service.
 5. Submittals.
 6. Recommended spare parts lists.
 7. Names and telephone numbers of major material suppliers and subcontractors.
 8. System schematic drawings.

1.14 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 01.

- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.15 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.16 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date

of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION WORK

- A. All demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include all items such as, but not limited to, existing piping, draining of piping, pumps, ductwork, supports and equipment where such items are not required for the proper operation of the modified system.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner shall move and store these materials. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- E. Clean and flush the interior and exterior of all existing relocated equipment and its related piping, valves, and

accessories that are to be reused of all mud, debris, pipe dope, oils, welding slag, loose mill scale, rust and other extraneous material so that the existing equipment and all accessories can be repainted and repaired as required to place in first-class working condition.

- F. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling or at mains. Cap or plug piping with same or compatible piping material.
- G. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
 - 1. Cap or plug piping with same or compatible piping material.
 - 2. Cap or plug ducts with same or compatible ductwork material.

3.2 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing,

containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.3 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 01.
- B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.4 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.5 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems.
 - 2. Heating Systems.

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3. Temperature Controls.
4. Exhaust Systems.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION 15010

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.

1.2 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 13 Fire Protection Sections, Division 15 Mechanical Sections, and Division 01 Specification Sections.

1.3 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.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.
5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.5 QUALITY ASSURANCE

A. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

- C. 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.
- D. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- E. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- F. Installer Qualifications:
1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
1. Protect equipment and materials from theft, injury or damage.
 2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
 3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
 4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to

Electrical Trades in good condition, receive written confirmation of same.

5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

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 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:

1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
2. Copper tube and pipe: Slip-on bronze flanges.

D. 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.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- G. Brazing Filler Metals: Alloys meeting AWS A5.8.
 - 1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
 - 2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.
- H. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- J. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- K. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- L. Solvent Cements for Joining ABS Piping: ASTM D 2235.
- M. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.
- N. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 PIPE THREAD COMPOUNDS

- A. Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.

1. Manufacturers:

- a. Carboline "Carbo-Zinc 12."
- b. Tnemec.
- c. Koppers.

- D. Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures for steam or condensate.

1. Manufacturers:

- a. WKM; Division of Cooper Industries, Inc., Key "Graphite Paste."
- b. Other approved.

- E. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.

1. Manufacturers:

- a. Cadillac Plastic.
- b. Permacel.
- c. Other approved.

2.5 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
 - a. IPEX Inc. (formerly Eslon Thermoplastics).
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Fernco, Inc.
- c. Mission Rubber Company.
- d. Plastic Oddities, Inc.
- e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
- f. Joint Inc., "Caulder".

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Capitol Manufacturing Co.
- d. Central Plastics Company.
- e. Epco Sales, Inc.
- f. Pipeline Seal and Insulator, Inc.
- g. Watts Water Technologies, Inc.; Watts Regulator Co.
- h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; female NPT threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Lochinvar Corp.; V-Line Insulating Couplings.

F. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:

- a. Anvil International, Inc.; Gruvlok Manufacturing; DI-LOK Nipples.
- b. Elster Group; Perfection Corp.; ClearFlow.
- c. Precision Plumbing Products, Inc.; ClearFlow.
- d. Sioux Chief Manufacturing Co., Inc.
- e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
- f. Victaulic Co. of America; Style 47 ClearFlow.

2.7 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
- b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
- d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
- e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2. Existing Piping: Use the following:

- a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
- b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
- c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

- 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
- 2. Design Mix: 5000-psi, 28-day compressive strength.
- 3. Packaging: Premixed and factory packaged.

2.10 EPOXY BONDING COMPOUND

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:

- 1. Euco 452 #450; Euclid Chemical Co.
- 2. Epobond; L & M Construction Chemicals.
- 3. Sikadur 87; Sika Corp.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.

- B. Install piping according to the following requirements and Division 15 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.
- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- M. Slope piping and arrange systems to drain at low points.

- N. Slope horizontal piping containing noncondensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. 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.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.

- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.
- CC. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- DD. Sleeves are not required for core-drilled holes in poured concrete walls.
- EE. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.

- d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 5. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- FF. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.
1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- GG. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Specification Sections for materials.
- HH. Seal openings around pipes in sleeves and around duct openings through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Fire and/or smoke barriers shall be UL listed firestopping and shall have a fire rating equal to or greater than the penetrated barrier. Refer to Division 07 Specification Sections for materials.
- II. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

JJ. Verify final equipment locations for roughing-in.

KK. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. 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."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- O. 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.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- S. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- T. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. 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.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
 - U. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
 - V. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
 - W. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
 - X. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
 - Y. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.
- 3.3 EQUIPMENT CONNECTIONS
- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
 - B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.
- 3.4 PIPING CONNECTIONS
- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- 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. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.6 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 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. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.
- D. Field Welding: Comply with AWS D1.1.

3.8 EPOXY BONDING TO EXISTING MATERIALS

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.9 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.10 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.

3.11 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.12 EXCAVATION AND BACKFILLING

- A. Refer to Division 02 Specification Sections.
- B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and

extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.13 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.14 LUBRICATION

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.15 FILTERS

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.16 CLEANING

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 15 Section "Domestic Water Piping."

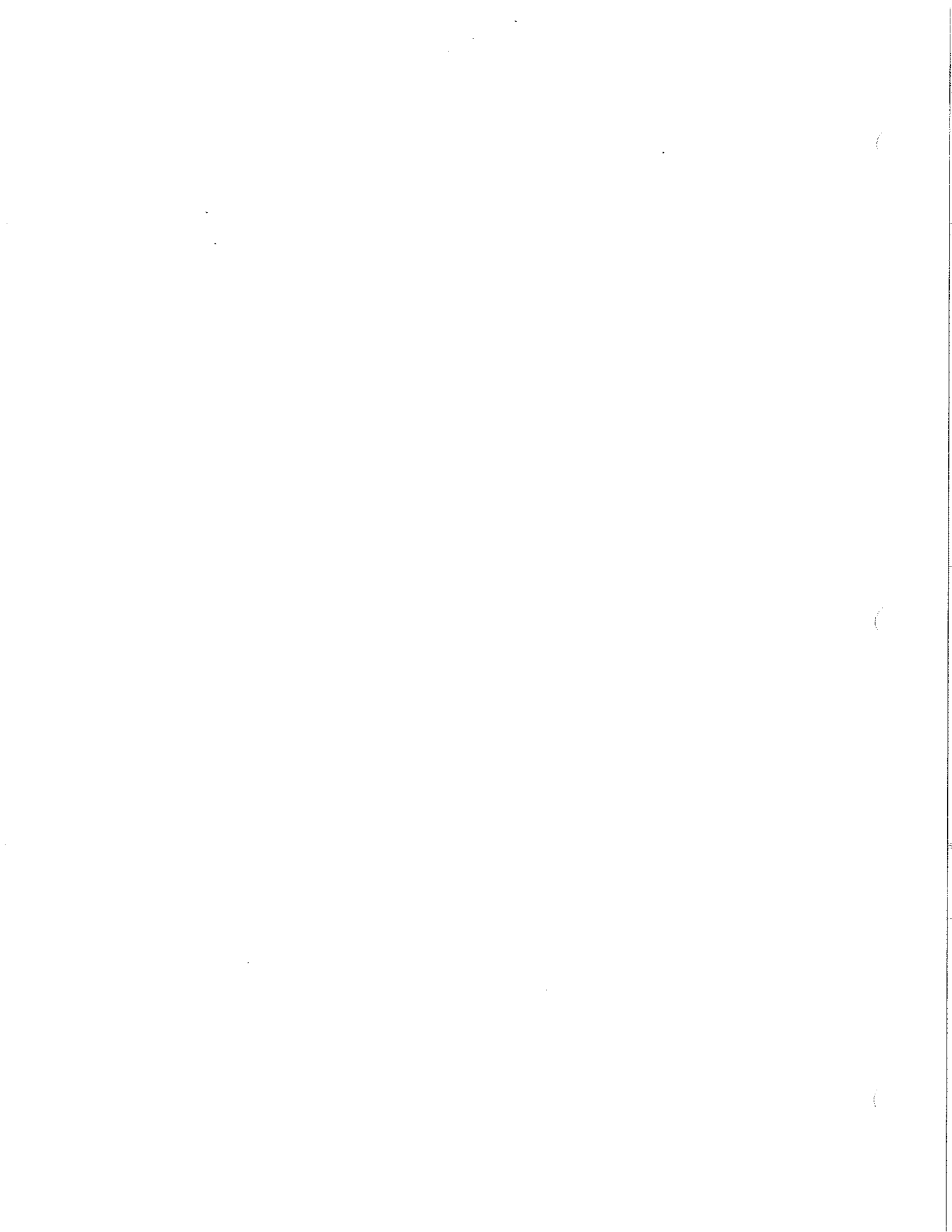
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- C. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- D. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 15050



SECTION 15053 - COMMON WORK RESULTS FOR HVAC

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Basic Mechanical Materials and Methods."
 - 3. Division 15 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.4 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC 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.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:

1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.4 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
- C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The

second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

- D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.
- F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.5 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.6 BELT DRIVE GUARDS

- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
- B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.7 AIR HANDLING SYSTEM BALANCING PROVISIONS

- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.
- B. Provide sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each existing air handling system requiring rebalancing during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.8 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 15 Section "Motors."

2.9 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

- 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe

maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.

2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.10 IDENTIFICATION

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.11 ACCESSORIES

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 15 HVAC equipment Sections for additional requirements.

END OF SECTION 15053

SECTION 15055 - MOTORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 "Mechanical General Requirements."
2. Division 15 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
3. Division 16 Section "Enclosed Switches and Circuit Breakers".
4. Division 16 Section "Enclosed Controllers".
5. Division 16 Section "Fuses".

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors, enclosed controllers, and disconnect switches.

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)
- B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.
- D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - d. Solid-state controllers.
 - e. Variable frequency controllers.
 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 3. Matched to torque and horsepower requirements of the load.
 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate electrical scope of work to be provided by Division 15 with this Section, related Division 15 Specifications, Division 16 Specifications and the Drawings.
- C. Electrical work provided under Division 15: Furnish UL Listed components in accordance with this section, Division 16, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- D. Furnished, installed and wired under Division 15 unless otherwise indicated:
1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
- E. Furnished and installed under Division 15 and wired under Division 16 unless otherwise indicated:
1. Motors required for mechanical equipment
 2. Packaged Self-Contained Equipment:
 - a. Provide equipment ready to accept a single electrical service connection.
 - b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.

3. Variable frequency controllers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:

1. Dayton.
2. Toshiba Intl.
3. Baldor Electric/Reliance.
4. Rockwell Automation/Allen-Bradley.
5. Emerson Motor Technologies; U.S. Electrical Motors.
6. Regal Beloit/GE Commercial Motors.
7. Regal Beloit/Leeson.
8. Regal Beloit/Marathon.
9. Siemens.

2.2 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.
2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 16.

- C. Electrical Power System Characteristics: As scheduled on the Drawings.

- D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. 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.
- H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
- I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

CENTER LINE PUBLIC SCHOOLS
 RISING STARS ACADEMY at
 MILLER ELEMENTARY SCHOOL

121440

MARCH 11, 2013

1800 RPM
 OPEN DRIP-PROOF
 MOTORS
 4 POLE

1800 RPM
 ENCLOSED MOTORS
 4 POLE

HP	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

1200 RPM
 OPEN DRIP-PROOF
 MOTORS
 6 POLE

3600 RPM
 OPEN DRIPPROOF
 MOTORS
 2 POLE

HP	NOMINAL	MINIMUM	NOMINAL	MINIMUM
	EFF	EFF	EFF	EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2

HP	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficient Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium" Induction Motors
 Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1

Nominal Efficiencies For "NEMA Premium™" Induction Motors
 Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
 Rated Medium Volts for 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

- D. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation:
 - 1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.

2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. 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.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.6 ENCLOSED CONTROLLERS

A. Provide enclosed controllers in accordance with requirements specified in Division 16 Section "Enclosed Controllers".

2.7 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 16 Section "Enclosed Switches and Circuit Breakers".

2.8 FUSES

A. Provide fuses in accordance with requirements specified in Division 16 Section "Fuses".

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for horsepower, speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control features for proper operation.
 - 5. Verify that current in each phase is within nameplate rating.
- C. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

3.2 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15055

SECTION 15060 - HANGERS AND SUPPORTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 15 Section "Mechanical General Requirements."

3. Division 15 Section "Basic Mechanical Materials and Methods."
4. Division 15 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.
5. Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
- C. MFMA: Metal Framing Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
1. MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 2. MSS SP-69, Pipe Hangers and Supports - Selection and Application.
 3. MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 5. ASME Boiler and Pressure Vessel Code: Section IX.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
1. Rod continuously threaded.
 2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-69, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support

Applications" Article for where to use specific hanger and support types.

1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:

1. Anvil International, Inc.
2. Cooper B-Line, Inc.
3. Carpenter & Paterson, Inc.
4. Hilti USA.
5. ERICO International Corp.
6. PHD Manufacturing, Inc.
7. Tolco | Cooper B-Line, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil International, Inc.; Anvil-Strut.
2. Cooper B-Line, Inc.
3. Power-Strut Div.; Tyco International, Ltd.
4. Unistrut Corp.; Tyco International, Ltd.
5. Hilti USA.
6. Tolco | Cooper B-Line, Inc.; TOLStrut.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 - D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
 - E. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- 2.6 METAL INSULATION SHIELDS
- A. Manufacturers:
 - 1. Anvil International, Inc.
 - 2. Cooper B-Line, Inc.
 - 3. Carpenter & Paterson, Inc.
 - 4. ERICO International Corp.
 - 5. PHD Manufacturing, Inc.
 - 6. Tolco | Cooper B-Line, Inc.
 - B. Description: MSS SP-69, Type 40, protective shields. Shields shall span an arc of 180 degrees.
 - C. Shield Dimensions for Pipe: Not less than the following:
 - 1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.
- 2.7 THERMAL-HANGER SHIELDS
- A. Manufacturers:
 - 1. Cooper B-Line, Inc.
 - 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 3. Rilco Manufacturing Company, Inc.
 - 4. American Mechanical Insulation Sales Inc. (AMIS).
 - 5. ERICO International Corp.
 - 6. Tolco | Cooper B-Line, Inc.
 - 7. Value Engineered Products, Inc.
 - B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.
 - 1. Minimum Compressive Strength of Insert Material:
 - a. 100-psig- for sizes smaller than NPS 6.

- b. 600-psig- for sizes NPS 6 and larger.
 - C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.
 - E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
 - F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.
 - G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:
 - 1. Manufacturers:
 - a. Cooper B-Line, Inc./Armacell; Armafix IPH.
 - b. Anvil International, Inc./Hydra-Zorb Company; Klo-Shure Insulation Couplings.
 - 2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use one of the following:
 - a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.
 - b. Rigid Hytrel thermoplastic insulation coupling designed for use with copper tubing and elastomeric insulation from 3/8 inch to 1 inch thick.
- 2.8 FASTENER SYSTEMS
- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Cooper B-Line, Inc.

- b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.
- B. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. MKT Fastening, LLC.
 - d. Powers Fasteners.
 2. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 3. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 4. Washer and Nut: Zinc-coated steel.
- C. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.
1. Manufacturers:
 - a. Superior Concrete Accessories; Threaded Insert.
 - b. Dayton Sure-Grip and Shore Co.
 - c. Richmond Screw Anchor Co.
- D. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.
1. Manufacturers:
 - a. Cooper B-Line, Inc.; B22-I Continuous Concrete Insert.
 - b. Unistrut Corp.; P-3200 Continuous Insert.
 - c. Hohman and Barnard, Inc.
 - d. Richmond Screw Anchor Co.

e. Hilti, Inc.; CIS13812/PG.

2.9 ROOF MOUNTED PIPING SUPPORTS

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Adjustable Compact Pipe Stand: Plastic or rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various pipe supporting elements.

1. Manufacturers:

- a. Cooper B-Line, Inc.; Dura-Blok.
- b. ERICO International Corp.
- c. MIRO Industries.
- d. Tolco | Cooper B-Line, Inc.; Pipe Piers.

- C. Low-Type, Single-Pipe Stand: Assembly of base and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

- a. Cooper B-Line, Inc.; Dura-Blok.
- b. ERICO International Corp.
- c. MIRO Industries.
- d. Portable Pipe Hangers.
- e. Tolco | Cooper B-Line, Inc.; Pipe Piers.

- 2. Base: Plastic, stainless steel, or recycled rubber.
- 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

2.10 ROOF MOUNTED EQUIPMENT SUPPORTS

- A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.
- B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.

1. Manufacturers:

- a. Cooper B-Line, Inc.; Dura-Blok.
- b. ERICO International Corp..
- c. MIRO Industries; HD and LD Mechanical Unit Supports.
- d. Portable Pipe Hangers.
- e. Tolco | Cooper B-Line, Inc.; Pipe Piers.

2. Base: Plastic, stainless steel, or recycled rubber.

3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.

C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.

1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.

a. Manufacturers:

- 1) Pate.
- 2) Thybar; TEMS Series.
- 3) Roof Products and Systems.
- 4) Greenheck.
- 5) Creative Metals.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- D. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- E. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Single Pipes
 - a. Support uninsulated pipe up to NPS 4 size with TYPE 1 or TYPE 10 attachments.
 - b. Support uninsulated pipe NPS 6 size through NPS 12 size with TYPE 1 attachments.
 - c. Support uninsulated pipe larger than NPS 12 size with double rod roller hangers, Type 41.
 - d. Support insulated pipe up to NPS 2 size with Type 1 attachments and Type 40 insulation shield.

- e. Support insulated cold piping NPS 2-1/2 to NPS 12 size with TYPE 1 attachment with thermal-hanger shield.
 - f. Support insulated cold piping larger than NPS 12 with Type 1 attachment with thermal-hanger shield.
 - g. Support insulated hot piping NPS 2-1/2 size through NPS 12 size with roller hangers TYPES 41, 43, 44 or 46 with thermal-hanger shield designed for use with a pipe roller.
 - h. Support insulated hot piping larger than NPS 12 size with double rod roller hangers, Type 41, with thermal-hanger shield designed for use with a pipe roller.
2. Parallel Pipes:
- a. Fabricate trapeze hangers from approved structural steel shapes in accordance with "Miscellaneous Materials" requirements or use commercially available proprietary design, rolled steel. Refer to applicable requirements for "Single Pipes" and "Metal Fabrications."
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. MSS Type 8 or spring type to meet system requirements.
- J. Insulation Shields and Thermal-Hanger Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. For Trapeze or Clamped Systems: For insulated piping use thermal-hanger shields to prevent crushing insulation.
 - 2. For Trapeze Systems Constructed of Metal Strut: Plastic shields may be used in exposed locations.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
 2. Beam Clamps:
 - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
 - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.
 3. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch NPS 4 reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:

- a. Provide spring supports at point of support where vertical movement will occur.
 - b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
 - c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
 - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
 - e. Sway braces; TYPE 50.
 - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- N. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use chemical fasteners instead of building attachments where required in concrete construction.
- 3.2 HANGER AND SUPPORT INSTALLATION
- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.
 - B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.
 - C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric

- insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
 - E. File and paint cut ends and shop or field prime paint supporting element components.
 - F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
 - G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
 - H. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
 - I. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.
 - J. Where necessary, brace piping and supports against reaction, sway and vibration.
 - K. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.

- L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the

American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

- T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- X. Building structure shall not be reinforced except as approved by the Architect in writing.
- Y. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.
- Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
- BB. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as

required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.

CC. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.

DD. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

EE. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

FF. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

GG. Roof-Mounting Pipe and Equipment Stand Installation:

1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.

- HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- JJ. 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.
- KK. Install lateral bracing with pipe hangers and supports to prevent swaying.
- LL. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- OO. Insulated Piping: Comply with the following:
1. Pipe smaller than NPS 2: Install adjustable swivel ring or clevis type hangers with protection shield.
 2. Cold Pipe NPS 2-1/2 and larger: Install clevis type hangers with thermal hanger shields.
 3. Hot Pipe NPS 2-1/2 through NPS 5: Install single rod roller hanger with thermal hanger shield.
 4. Hot Pipe NPS 6 and larger: Install 2-rod roller hanger with thermal hanger shield.
 5. Trapeze Supported Pipe NPS 2 and smaller: Install with protection shield and secure to trapeze support with standard U-bolts and locknuts.

6. Trapeze Supported Cold Pipe NPS 2-1/2 and larger:
Install with thermal hanger shield and secure to
trapeze support with standard U-bolts and locknuts.
7. Trapeze Supported Hot Pipe NPS 2-1/2 and larger:
Install thermal hanger shield and cradle pipe in
adjustable cast iron roller support.

PP. Refer to individual piping sections for hanger spacing and
hanger rod sizes.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment
from structure overhead or to support equipment above
floor.
- B. Grouting: Place grout under supports for equipment and
make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment
supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for
trapeze pipe hangers.
- 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.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch 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.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- 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

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) 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.

1.4 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).
 - 7. Kolbi Pipe Marker Co.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include 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 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to

pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.
- F. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
- B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme to match existing numbering scheme. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed,

or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

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 and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
3. Fans, blowers, primary balancing dampers, and mixing boxes.
4. Packaged HVAC central-station and zone-type units.

B. 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. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. 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 nonconcealed 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 nonaccessible 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.
- 3.4 DUCT IDENTIFICATION
- A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:
1. Refer to Schedule.

2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
 3. 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.
- B. Identify ductwork with vinyl markers and flow direction arrows.
 - C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.
- 3.5 VALVE-TAG INSTALLATION
- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- 3.6 VALVE-SCHEDULE INSTALLATION
- A. Mount valve schedule on wall in accessible location in each major equipment room.
- 3.7 WARNING-TAG INSTALLATION
- A. Write required message on, and attach warning tags to, equipment and other items where required.
- 3.8 ADJUSTING
- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- 3.9 CLEANING
- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.10 SCHEDULES

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

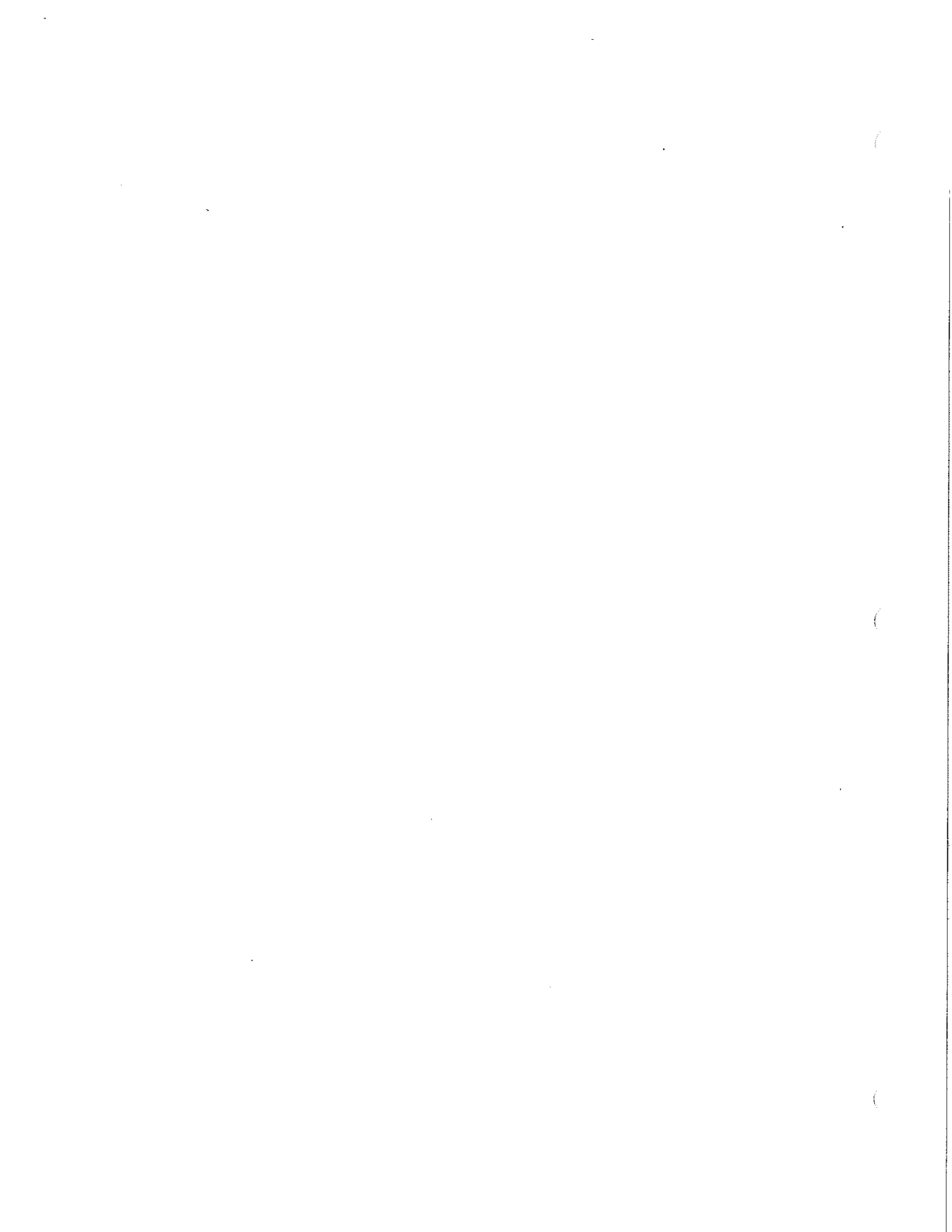
PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Ab- brev.</u>	<u>Labels</u>	<u>Piping</u>
Hot Water Htg. Supply	HWHS	Black on Yel- low	Dark Blue
Hot Water Htg. Return	HWRH	Black on Yel- low	Dark Blue

SHEET METAL WORK

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>	<u>Ductwork</u>
Air Conditioning Sup- ply	Supply Air	White on Green	White
Air Conditioning Re- turn	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green

END OF SECTION 15075



SECTION 15080 - MECHANICAL INSULATION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."
2. Division 15 Section "Basic Materials and Methods."
3. Division 15 Section "Hanger and Supports" for thermal hanger shield inserts.
4. Division 15 Section "Plumbing Fixtures: for protective shielding guards.
5. Division 15 Section "Metal Ducts" for duct liners.

1.2 SUMMARY

- A. This Section includes mechanical insulation for pipe, duct, and equipment.
- B. After completion of asbestos abatement, reinsulate all existing systems including piping, fittings, ductwork, equipment, etc. which are remaining in service.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVC: Polyvinyl Chloride.
- E. PVDC: Polyvinylidene chloride.
- F. SSL: Self-sealing lap.

1.4 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.5 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

B. Field quality-control inspection reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.9 COORDINATION

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

- C. Coordinate installation and testing of heat tracing.

1.10 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Armacell LLC; AP Armaflex.
 - b. Nomaco K-Flex; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Johns Manville; Micro-Lok.
- b. Knauf Insulation; 1000 Pipe Insulation.
- c. Manson Insulation Inc.; Alley-K.
- d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. CertainTeed Corp.; Duct Wrap.
- b. Johns Manville; Microlite.
- c. Knauf Insulation; Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap FSK.
- e. Owens Corning; All-Service Duct Wrap.

2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Armacell LCC; 520 Adhesive.
- b. Foster Products Corporation, H. B. Fuller Company; 85-75.
- c. RBX Corporation; Rubatex Contact Adhesive.

- C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.

- c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
- d. Marathon Industries, Inc.; 550.
- e. Mon-Eco Industries, Inc.; 55-50.
- f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Johns Manville; Zeston and Ceel-Co.
- b. P.I.C. Plastics, Inc.; FG Series.
- c. Proto PVC Corporation; LoSmoke.
- d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated tank heads and tank side panels.

- C. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Johns Manville; Zeston and Ceel-Co.
- b. P.I.C. Plastics, Inc.; FG Series.
- c. Proto PVC Corporation; LoSmoke.
- d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers:
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

2.7 TAPES

- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.8 SECUREMENTS

- A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers:

- 1) GEMCO.
- 2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers:

- a. ACS Industries, Inc.
- b. C & F Wire.
- c. PABCO-Childers Metals; ITW Insulation Systems.
- d. RPR Products, Inc.

2.9 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

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.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.
- E. Install 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. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.

- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
 1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- E. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
 2. Pipe: Install insulation continuously through floor penetrations.

- a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe

- diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over

adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:

- a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- 3.8 DUCT AND PLENUM INSULATION INSTALLATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive may be omitted from top surface of horizontal rectangular ducts.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.

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- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 15080



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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 15 piping Sections for specialty valves applicable to those Sections only.
 - 3. Division 15 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general HVAC and plumbing applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general HVAC and plumbing valve applications, use the following:
1. Shutoff Service: Ball, butterfly valves.
 2. Throttling Service: Angle, ball, butterfly, or globe valves.
 3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
 - B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
- b. Crane Valve Group; Crane Valves.
- c. Milwaukee Valve Company; Model BA100S.
- d. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
- e. Watts Water Technologies, Inc.

2.3 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; by Conbraco Industries, Inc.
- b. Crane Valve Group; Crane Valves.
- c. Crane Valve Group; Stockham Div.
- d. Hammond Valve.
- e. Milwaukee Valve Company; Model 515.
- f. NIBCO INC.; Models S-433-B or T-433-B.
- g. SSI Equipment, Inc.
- h. Watts Water Technologies.

2.4 BRONZE ANGLE VALVES

A. Bronze Angle Valves, General: MSS SP-80, with silicon bronze stem, non-asbestos packing and malleable-iron handwheel.

B. Class 150, Bronze Angle Valves: ASTM B 62 bronze body with TFE disc, union-ring bonnet, threaded ends, and having 300-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Valve Group; Crane Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company; Model 595T.
- d. NIBCO INC.; Model T-335-Y.
- e. Powell, Wm. Co.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Bronze ball valve as specified in this Section.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

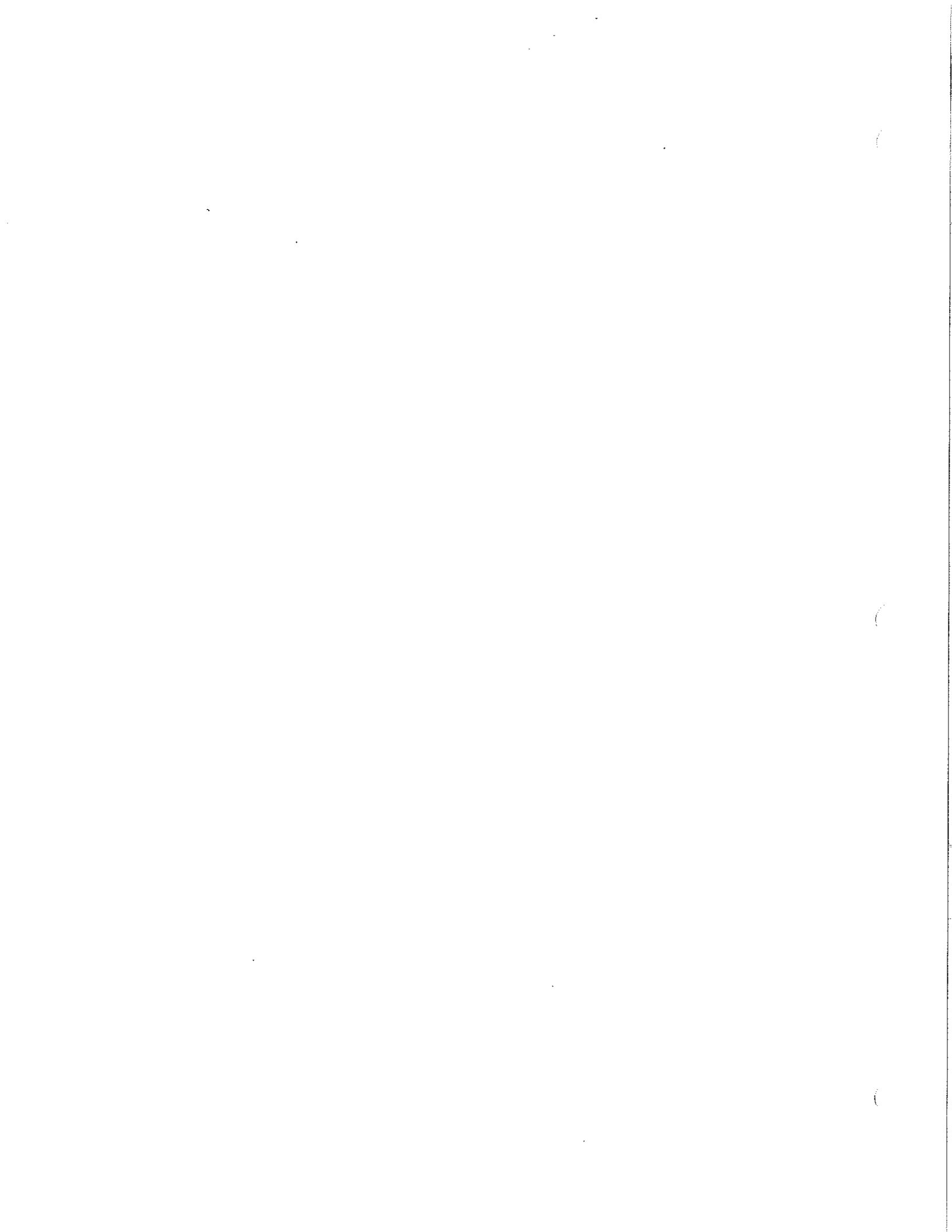
3.3 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 15110



SECTION 15121 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND
LOOPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).
- C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. NBR: Buna-N/Nitrile rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FLEXIBLE CONNECTORS

- A. Hose and Braid Flexible Connectors:

- 1. Manufacturers:

- a. Adsko Manufacturing, LLC.
- b. Flex-Weld, Inc.
- c. Hyspan Precision Products, Inc.
- d. Metraflex, Inc.
- e. Senior Flexonics, Inc.; Pathway Division.
- f. Twin City Hose, Inc.

- 2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.
- 3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.

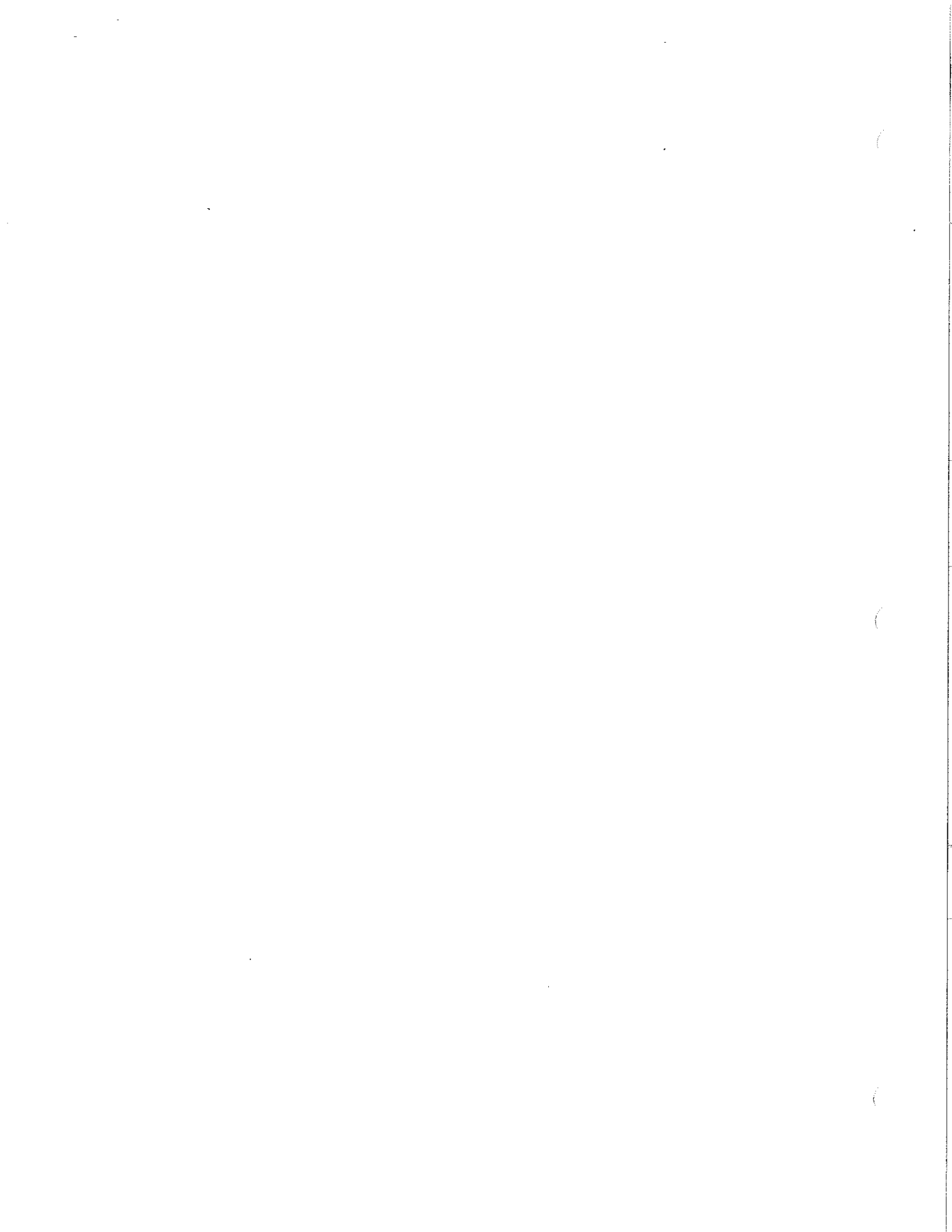
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 450 deg F for copper piping connectors, 800 deg F for steel piping connectors.

PART 3 - EXECUTION

3.1 FLEXIBLE CONNECTOR APPLICATIONS

- A. Use hose and braid flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.
 1. Flexible Connectors: Stainless steel hose and braid style with threaded end connections for pipe sized NPS 2 and smaller.
 2. Flexible Connectors: Stainless steel hose and braid style with steel flange end connections for pipe sized NPS 2-1/2 and larger.

END OF SECTION 15121



SECTION 15128 - HEAT TRACING FOR PLUMBING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 20 Section "Mechanical General Requirements."

1.2 SUMMARY

A. Section includes plumbing piping heat tracing for domestic hot-water-temperature maintenance, with the following electric heating cables:

1. Self-regulating, parallel resistance.

1.3 DEFINITIONS

A. BAS: Building Automation System.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Delegated-Design Submittal:
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- C. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL acceptable to authorities having jurisdiction, and marked for intended location and application.

1.6 COORDINATION

- A. Coordinate with installation of piping insulation.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES FOR DOMESTIC HOT WATER TEMPERATURE MAINTENANCE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Thermon Americas Inc.; WarmTrace.
 - 2. Raychem; a brand of Tyco Thermal Controls LLC.; HWAT.
- B. Comply with IEEE 515.1.

- C. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper braid and color coded polyolefin outer jacket.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Capacities and Characteristics:
1. Nominal Maintenance Temperature:
 - a. 125 deg F when powered at 208 Vac.
 2. Piping Diameter: As indicated on the Drawings.
 3. Electrical Characteristics for Single-Circuit Connection: Coordinate electrical system requirements with Division 26.
- H. Electrical Power System Characteristics: As scheduled on the Drawings.
- I. Installation Accessories:
1. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
 2. Warning Labels: Self-adhesive labels with legend "ELECTRIC HEAT TRACING." Refer to Division 20 Section "Mechanical Identification" for additional requirements
 3. Warning Tape: Continuously printed "Electrical Tracing"; vinyl with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - a. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

- b. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.2 CONTROLS

- A. Programmable Timer for Domestic Hot-Water-Temperature Maintenance:
 - 1. Microprocessor based.
 - 2. Minimum of four separate schedules.
 - 3. Minimum 24-hour battery carryover.
 - 4. On-off-auto switch.
 - 5. 365-day calendar with 20 programmable holidays.
 - 6. Relays with contacts to indicate operational status, on or off, and for interface with central BAS workstation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.

2. Install insulation over piping with electric heating cables according to Division 20 Section "Mechanical Insulation."
 3. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- C. Set field-adjustable switches and circuit-breaker trip ranges.
- 3.3 CONNECTIONS
- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
 - B. Connect wiring according to Division 26 Section "Conductors and Cables."
- 3.4 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 2. Test cables for electrical continuity and insulation integrity before energizing using 2500 Vdc megohmmeter (megger).
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
 - B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
 - C. Cables will be considered defective if they do not pass tests and inspections.
 - D. Remove and replace damaged heat-tracing cables.
 - E. Prepare test and inspection reports.

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3.5 PROTECTION

- A. Protect installed heating cables, including non-heating leads, from damage during construction.

END OF SECTION 15128

SECTION 15140 - DOMESTIC WATER PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."
2. Division 15 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
3. Division 15 Section "Hangers and Supports."
4. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 15 Section "Valves" for general duty valves.

6. Division 15 Section "Domestic Water Piping
Specialties" for water distribution piping
specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping inside the building.

1.3 DEFINITIONS

- A. PEX: Crosslinked polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.5 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

- B. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Drain Duty: Hose-end drain valves.

- C. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.6 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.7 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K, 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 ends. 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, Type L, 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 ends. 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.
- C. Grooved-Joint Systems:
1. Manufacturers:
 - a. Anvil International, Inc.; Gruvlok Manufacturing; Model 7401.
 - b. Tyco Fire & Building Products; Grinnell Mechanical Products; Model 672.
 - c. Victaulic Company; Style 606 and Style 607.
 2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
 3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
- D. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Viega North America; ProPress System.
 - b. NIBCO Inc.; Press System.
 - c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
 - d. Apollo Valves; by Conbraco Industries; ApolloXpress.
 2. Housing: Copper.
 3. O-Rings and Pipe Stops: EPDM.
 4. Tools: Manufacturer's special tools.
 5. Maximum 200-psig working-pressure rating at 250 deg F.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. T-DRILL Industries Inc.

2.4 VALVES

- A. General-duty valves; and drain valves are specified in Division 15 Section "Valves."

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 02 Section "Earthwork."

3.2 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Install under-building-slab copper tubing according to Copper Development Association's "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.

- C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- D. 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.
- E. Install domestic water piping level without pitch and plumb.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60-inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- H. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to the following:
 - 1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. 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."

3. 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.

3.6 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been 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 final inspection for 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. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has

been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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.

3.7 ADJUSTING

A. Perform the following adjustments 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.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:

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:

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- 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.

C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 15140

SECTION 15145 - DOMESTIC WATER PIPING SPECIALTIES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."
2. Division 15 Section "Basic Mechanical Materials and Methods."
3. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 15 Section "Domestic Water Piping" for water meters.
5. Division 15 Section "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
6. Division 15 Section "Emergency Plumbing Fixtures" for water tempering equipment.

7. Division 15 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; Conbraco Industries, Inc.
- b. FEBCO; a Division of Watts Water Technologies, Inc.
- c. Watts Water Technologies, Inc.; Watts Regulator Co.
- d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.

4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Woodford Manufacturing Company.
2. Standard: ASSE 1011.
3. Body: Bronze or brass, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.

- b. Watts Water Technologies, Inc.; Watts Regulator Co.
- c. Zurn Plumbing Products Group; Wilkins Div.

- 2. Standard: ASSE 1022.
- 3. Operation: Continuous-pressure applications.
- 4. Size: NPS 1/4 or NPS 3/8.
- 5. Body: Stainless steel or Acetal plastic.
- 6. End Connections: Threaded.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - b. Bradley Corporation.
 - c. Lawler Manufacturing Company, Inc.
 - d. Leonard Valve Company; Series 170 and 270.
 - e. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series e480 and LM495.
 - f. Watts Water Technologies, Inc.; Watts Regulator Co.
 - g. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1070.
- 3. Pressure Rating: 125 psig.
- 4. Type: Thermostatically controlled water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
- 7. Accessories: Adjustable temperature-control knob.
- 8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
- 9. Minimum Flow Rate: 0.5 gpm.
- 10. Valve Finish: Rough bronze.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Manufacturers:

- a. Apollo Valves; Conbraco Industries, Inc.
 - b. Keckley.
 - c. Metraflex.
 - d. Mueller Steam Specialty.
 - e. NIBCO, Inc.
 - f. Spence.
 - g. SSI Equipment, Inc.
 - h. Watts Water Technologies, Inc.
 - i. Yarway.
2. CWP: 200 psig minimum, unless otherwise indicated.
 3. SWP: 125 psig minimum, unless otherwise indicated.
 4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 6. Screen: Stainless steel with round perforations, unless otherwise indicated.
 7. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 8. Drain: Factory-installed, hose-end drain valve.

2.5 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.6 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

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 backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install Y-pattern strainers for water on supply side of each control valve.

E. Install water hammer arresters in water piping according to PDI-WH 201.

F. Install air vents at high points of water piping.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

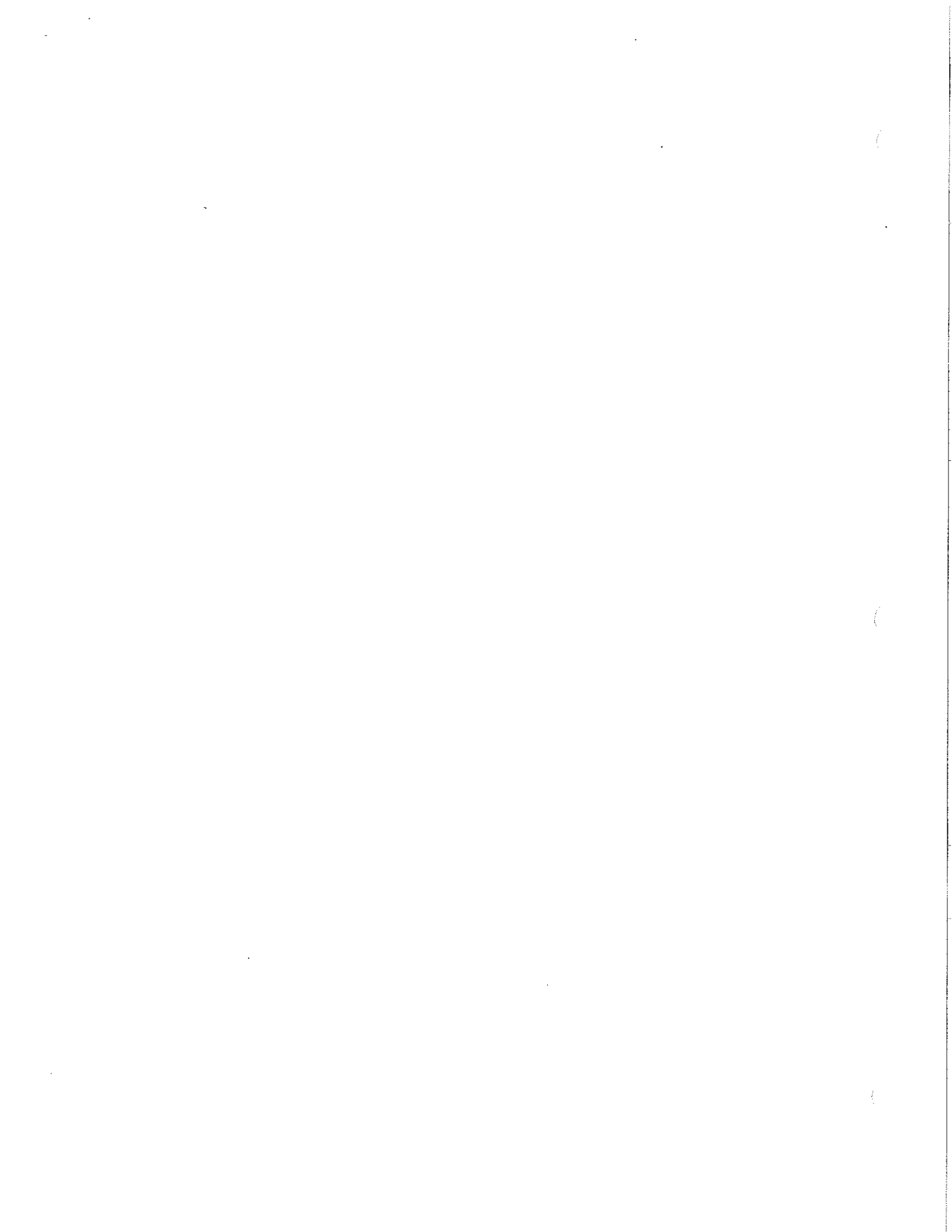
1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."

3.4 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 15145



SECTION 15150 - SANITARY WASTE AND VENT PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 02 Section "Sanitary Sewage" for piping outside building.
 - 2. Division 15 Section "Mechanical General Requirements".
 - 3. Division 15 Section "Basic Mechanical Materials and Methods".
 - 4. Division 15 Section "Drainage Piping Specialties".

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.

- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - C. LLDPE: Linear, low-density polyethylene plastic.
 - D. NBR: Acrylonitrile-butadiene rubber.
 - E. PE: Polyethylene plastic.
 - F. PVC: Polyvinyl chloride plastic.
 - G. TPE: Thermoplastic elastomer.
- 1.3 SYSTEMS DESCRIPTIONS
- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.
- 1.4 SUBMITTALS
- A. Product Data: For pipe, tube, fittings, and couplings.
 - B. Field quality-control inspection and test reports.
- 1.5 QUALITY ASSURANCE
- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
 - B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
 - 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.
- 1.6 PROJECT CONDITIONS
- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

- B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:

- a. ANACO-Husky.
- b. Ferguson Enterprises, Inc.; ProFlo (Private labeled Ideal Clamp Products, Inc.).
- c. Ideal Clamp Products, Inc.; a Tomkins Company.
- d. Mission Rubber Company; a division of MCP Industries, Inc.
- e. Tyler Pipe.

2. Standards: CISPI 310.

3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

- C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

- a. ANACO-Husky; SD 4000.
- b. Clamp-All Corp; 125.
- c. Ferguson Enterprises, Inc.; ProFlo (Private labeled Ideal Clamp Products, Inc.).
- d. Ideal Clamp Products, Inc.; a Tomkins Company.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Sanitary sewer piping outside the building is specified in Division 02 Section "Sanitary Sewerage."
- C. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

- F. 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."
- G. 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.
- H. 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.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- L. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 15 Section "Valves."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports."

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. 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.
 - 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.
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 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 15 Section "Mechanical Identification."

3.8 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. 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

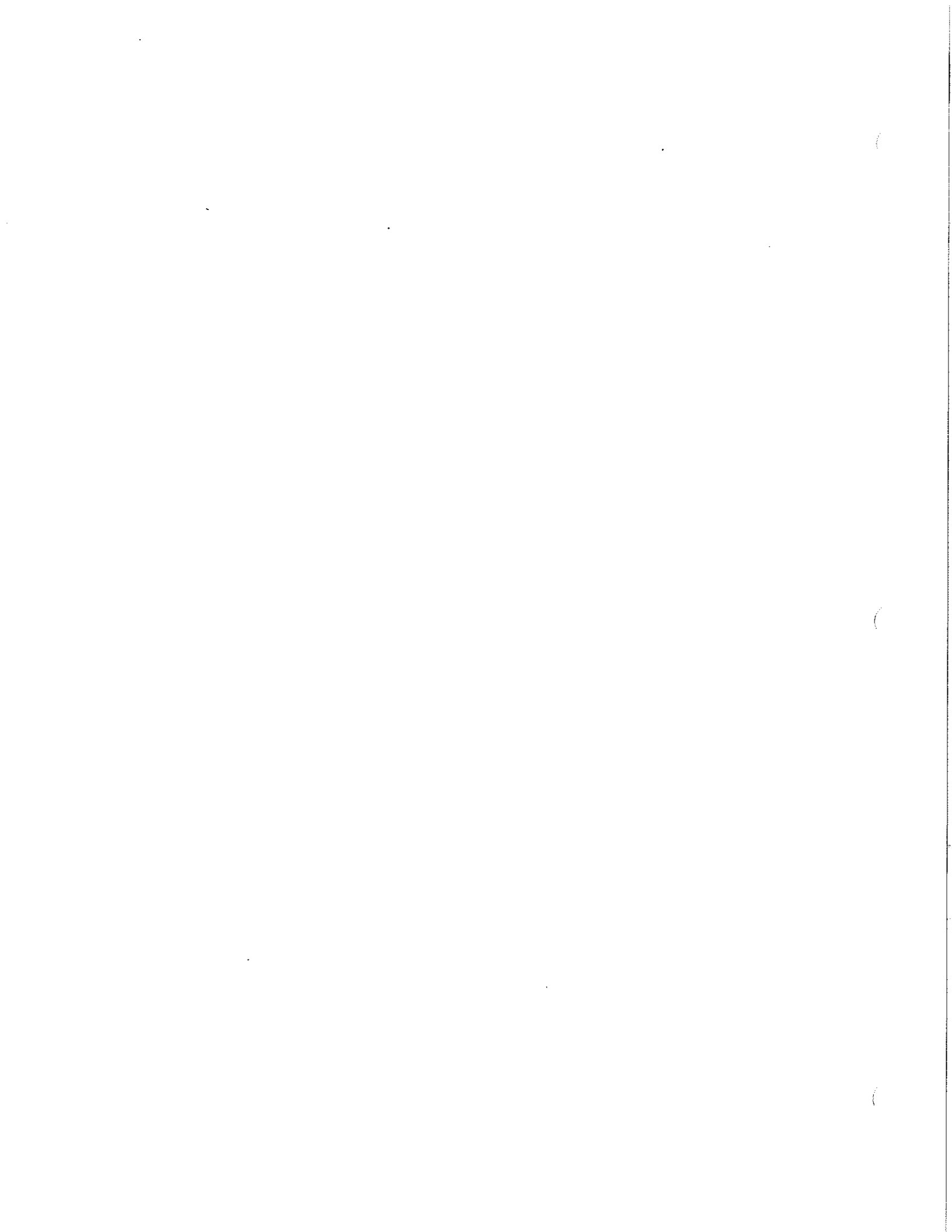
it has been tested and approved. Expose work that was covered or concealed before it was tested.

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.

3.9 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.

END OF SECTION 15150



SECTION 15155 - DRAINAGE PIPING SPECIALTIES

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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 "Mechanical General Requirements."
2. Division 15 Section "Basic Mechanical Materials and Methods."
3. Division 15 Section "Plumbing Fixtures" for hair interceptors.

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1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PUR: Polyurethane plastic.
- H. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for frost-resistant vent terminals.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Drainage piping 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 NRTL acceptable to authorities having jurisdiction, and marked for intended use.

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- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CAST-IRON CLEANOUTS

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

- B. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company; Josam Div.
- b. MIFAB, Inc.; C1220-R.
- c. Sioux Chief Manufacturing Company, Inc.
- d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
- e. Tyler Pipe; Wade Div.
- f. Watts Drainage Products Inc.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.
- h. Oatey.
- i. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas,

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and recessed cover to accept floor finish material in finished floor areas.

10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, [Extra-Heavy] Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Model 58790-20.
 - b. MIFAB, Inc.; C1460-RD.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. MIFAB, Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

D. Exterior Unsurfaced Area (Outdoor) Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

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- h. Oatey.
- i. Zurn Plumbing Products Group; Light Commercial Operation.

- 2. Standard: ASME A112.36.2M.
- 3. Type: Cast-iron soil pipe with cast-iron ferrule.
- 4. Body or Ferrule: Cast iron.
- 5. Outlet Connection: Spigot.
- 6. Cover Material and Finish: Epoxy coated cast- or ductile-iron with neoprene gasket.
- 7. Cover Shape: Round.
- 8. Top Loading Classification: Heavy Duty.
- 9. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.2 PLASTIC CLEANOUTS

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.

- B. Plastic Floor Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.
 - b. Canplas LLC.
 - c. IPS Corporation.
 - d. MIFAB, Inc.
 - e. NDS Inc.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Body: PVC.
- 3. Closure Plug: PVC.
- 4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 FLOOR DRAINS

- A. Plastic Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) FD-1:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. MIFAB, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: PVC.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Not Required.
9. Top or Strainer Material: Stainless steel (Nickel bronze in toilet rooms).
10. Top of Body and Strainer Finish: Stainless steel (Nickel bronze in toilet rooms).
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 6-1/2 inch diameter.
13. Top Loading Classification: Light Duty.
14. Funnel: Not required.
15. Trap-Seal Protection Device: Required.

B. Plastic Funnel Floor Drains, FFD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. MIFAB, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.

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- g. Sioux Chief Manufacturing Company, Inc.
- h. Zurn Plumbing Products Group; Light Commercial Operation.

- 2. Standard: ASME A112.6.3.
- 3. Pattern: Floor drain.
- 4. Body Material: PVC.
- 5. Seepage Flange: Required.
- 6. Clamping Device: Required.
- 7. Outlet: Bottom.
- 8. Coating on Interior and Exposed Exterior Surfaces: Not Required.
- 9. Top or Strainer Material: Stainless steel.
- 10. Top of Body and Strainer Finish: Stainless steel.
- 11. Top Shape: Round, with vandal proof screws.
- 12. Dimensions of Top or Strainer: 6-1/2 inch diameter.
- 13. Top Loading Classification: Light Duty.
- 14. Funnel: Required.
- 15. Trap-Seal Protection Device: Not required.

C. Plastic Floor Sinks, FS-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. MIFAB, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
- 3. Material: PVC.
- 4. Seepage Flange: Required.
- 5. Clamping Device: Required.
- 6. Outlet: Bottom.
- 7. Sediment Screen: Required.
- 8. Top or Strainer Material: Plastic.
- 9. Top of Body and Strainer Finish: Plastic.
- 10. Top Shape: Square.

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11. Dimensions of Top or Strainer: 12 inch by 12 inch, PVC, three-quarter grate, and stainless steel mesh screen.
12. Trap Material: Plastic drainage piping.
13. Trap Pattern: Standard P-trap.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Engineering Company; Elmdor/Stoneman Div.
- b. Thaler Metal Industries Ltd.

- B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.5 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. SureSeal Manufacturing; Inline Floor Drain Trap Sealer.

2. Standard: ASSE 1072-2007.
3. Body: ASB Plastic.
4. Diaphragm & Sealing Gasket: Neoprene Rubber.
5. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
6. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.6 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe

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fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.

2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

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2.7 FLASHING MATERIALS

- A. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 GREASE INTERCEPTORS

A. Grease Interceptors GT-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Lowe Engineering; a div. of Highland Tank & Manufacturing Co., Inc.
 - c. MIFAB, Inc.
 - d. Schier Products Company.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group.
 - i. Applied Chemical Technology, Incorporated.
 - j. Rockford Sanitary Systems, Inc.
 - k. Zurn Plumbing Products Group; Light Commercial Operation.
 - l. Ashland Trap Distribution Co.
 - m. Bio-Microbics, Inc.

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n. Canplas LLC.

2. Standard: ASME A112.14.3 and PDI-G101, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.
3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
5. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Body Dimensions: Refer to drawings.
7. Body Extension: Not required.
8. Flow Rate: Refer to drawings.
9. Grease Retention Capacity: Refer to drawings.
10. Inlet and Outlet Size: Refer to drawings.
11. End Connections: Hub.
12. Cleanout: Integral.
13. Mounting: Recessed, flush with floor.
14. Flow-Control Fitting: Required.
15. Operation: Manual cleaning.

2.9 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Rockford Sanitary Systems, Inc.
 - h. Schier Products Company.
 - i. Ashland Trap Distribution Co.
 - j. Schier Products Company.
 - k. Town & Country Plastics, Inc.
2. Type: Factory-fabricated interceptor made for removing and retaining food particles from wastewater.

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3. Body Material: Plastic.
4. Interior Separation Device: Screens.
5. Interior Lining: Not required.
6. Exterior Coating: Not required.
7. Body Dimensions: 25 inch by 19 inch by 14-1/4 inch.
8. Liquid Gallon Capacity Flow Rate: 15 gallons.
9. Inlet and Outlet Size: 3 inch.
10. End Connections: Threaded.
11. Mounting: Recessed, flush with floor.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Anchor grease interceptors and solids interceptors to concrete bases.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Concrete base construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
 6. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.2 INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

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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.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. 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.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

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- H. Assemble open drain fittings and install with top of hub 1 inch above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- M. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 2. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 3. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- N. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- P. 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 pipe fittings.

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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. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Ground equipment according to Division 16 Section "Grounding and Bonding."
- E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.

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- D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
 - G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
- 3.5 LABELING AND IDENTIFYING
- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Grease interceptors.
 - 2. Solids interceptors.
 - B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."
- 3.6 FIELD QUALITY CONTROL
- A. Perform tests and inspections and prepare test reports.
 - B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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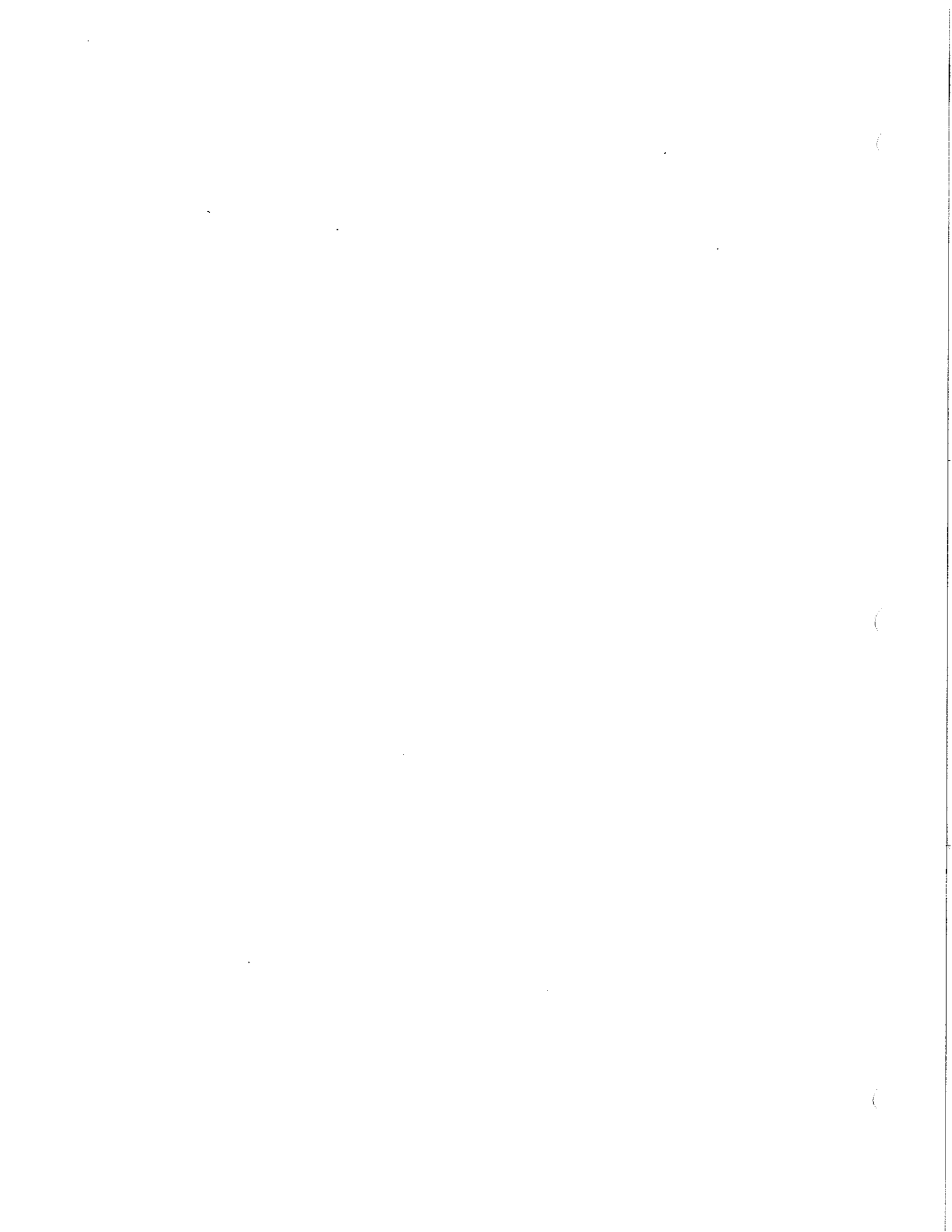
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3.7 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15155



SECTION 15194 - FUEL GAS PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."
2. Division 15 Section "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes facility fuel gas piping.

1.3 DEFINITIONS

- A. Gas Main: Utility's natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Point of Delivery: Piping outlet from assembly.
- D. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices inside the building.
- E. PE: Polyethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: Performance requirements are scheduled on the Drawings.
 - 2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig.

1.5 SYSTEMS DESCRIPTIONS

- A. Fuel gas piping system materials are scheduled on the Drawing.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with

proper precautions and do not leave on premises from end of one day to beginning of next day.

- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 COORDINATION

- A. 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 not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 BLACK STEEL PIPE AND FITTINGS

- A. Black Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.3 PIPING SPECIALTIES

- A. Flexible Connectors: ANSI Z21.24, copper alloy.
- B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.
- C. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods."

2.5 SPECIALTY VALVES

- A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
- B. Gas Valves, NPS 3 and Smaller: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 125-psig minimum pressure rating.

1. Manufacturers:

- a. Conbraco Industries, Inc.
- b. Crane Valves.
- c. Jomar International Ltd.
- d. Legend Valve and Fitting, Inc.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Water Technologies, Inc.; Watts Regulator Co.

- 2. Tamperproof Feature: Include design for locking.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 EXAMINATION

- A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

- B. Inspect natural-gas piping according to NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.4 PIPING SYSTEM INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- E. Concealed Locations:
 - 1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.
 - 2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.
 - 3. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.

4. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
- F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- I. Connect branch piping from top or side of horizontal piping.
- J. Install strainer on inlet of each automatic and electrically operated valve.
- K. Locate valves for easy access.
- L. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- M. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- N. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Use materials suitable for fuel gas.
- C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
- C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.8 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
2. Nameplates, pipe identification, and signs are specified in Division 15 Section "Mechanical Identification."
3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

3.9 PAINTING

- A. Use materials and procedures in Division 09 painting Sections.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
 - d. Color: Gray.

- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

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3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psig for a minimum of 2 hours.
- D. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 15194

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 15 Section "Mechanical General Requirements."
3. Division 15 Section "Basic Mechanical Materials and Methods."
4. Division 15 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.

5. Division 15 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
1. 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- 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"; for 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.
- G. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets: (Refer to Plumbing Fixture Schedule and Drawings.)

2.2 WATER CLOSET FLUSHOMETERS

- A. Flushometers: (Refer to Plumbing Fixture Schedule and Drawings.)

2.3 TOILET SEATS

- A. Toilet Seats, TS-1:

1. Toilet Seats: (Refer to Plumbing Fixture Schedule and Drawings.)

2.4 LAVATORIES

- A. Lavatories, LAV-1:

1. Lavatories: (Refer to Plumbing Fixture Schedule and Drawings.)

2.5 LAVATORY FAUCETS

- A. Lavatory Faucets: (Refer to Plumbing Fixture Schedule and Drawings.)

2.6 FIXTURE SUPPLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft; a Masco Company.
2. McGuire Mfg. Co., Inc.
3. Any of the approved plumbing fixture manufacturers.

- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.7 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers (PSG-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Engineered Brass Co.
- b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.

- c. McGuire Manufacturing Co., Inc.
- d. Plumberex Specialty Products Inc.
- e. TCI Products; SG-200BV.
- f. TRUEBRO, Inc.
- g. Zurn Plumbing Products Group; Z8946-3-NT.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.8 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

- B. Lavatory Supports:

1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

- C. Sink Supports:

1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
 - a. Type I, sink carrier with exposed arms and tie rods.
 - b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
 - c. Type III, sink carrier with hanger plate and exposed arms.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install counter-mounting fixtures in and attached to casework.
- E. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- F. 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.
 - 1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
- G. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 15 Section "Domestic Water Piping Specialties."

- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
- K. Install toilet seats on water closets.
- L. 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.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. 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. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
- 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. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing 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.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

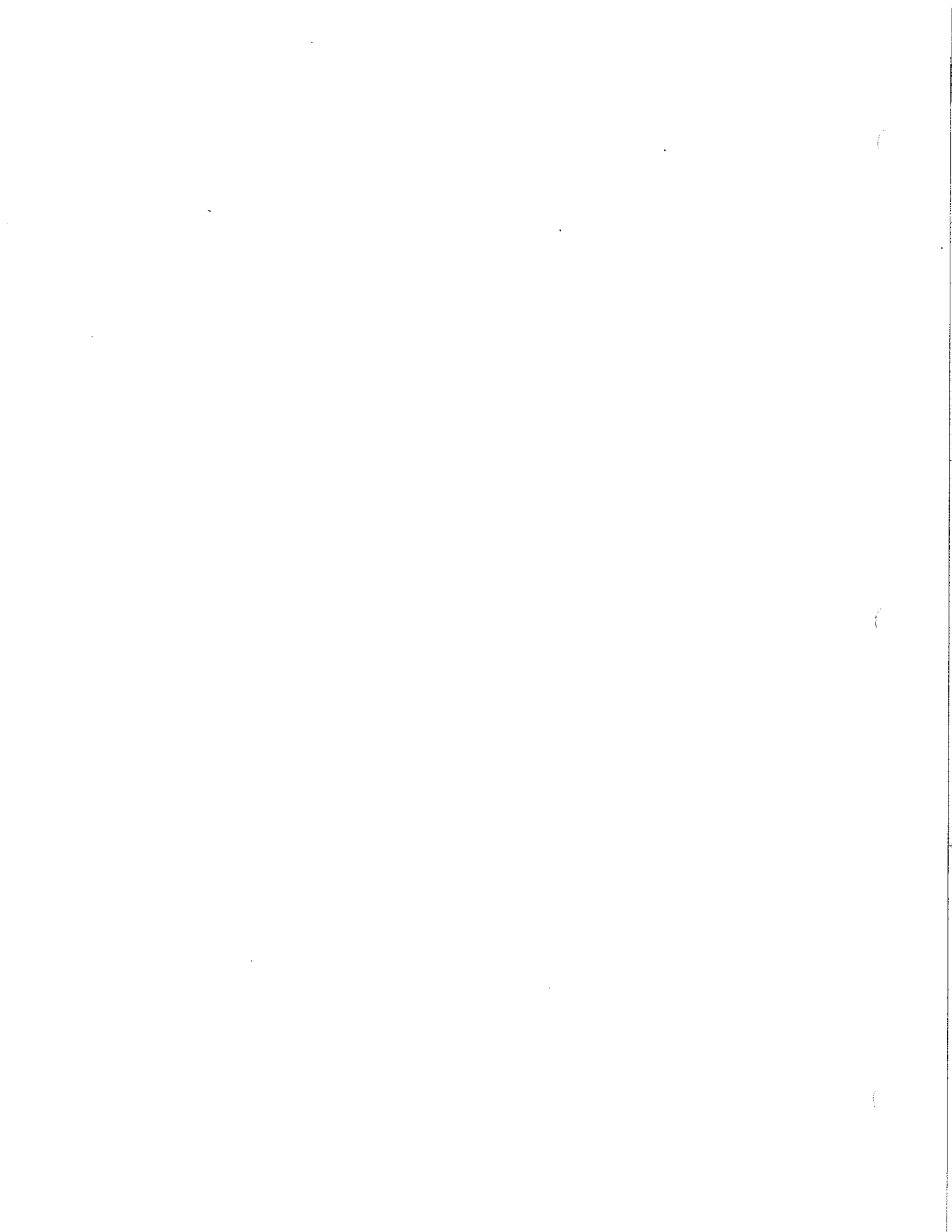
3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410



SECTION 15815 - METAL DUCTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."

2. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems in pressure classes from minus 6- to plus 6-inch wg.

1.3 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. FRP: Fiberglass-reinforced plastic.
- D. PVC: Polyvinyl Chloride.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

- A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Duct layout indicating sizes and pressure classes.
 3. Elevations of top and bottom of ducts.
 4. Dimensions of main duct runs from building grid lines.

5. Fittings.
 6. Reinforcement and spacing.
 7. Seam and joint construction.
 8. Penetrations through fire-rated and other partitions.
 9. Equipment installation based on equipment being used on Project.
 10. Duct accessories, including access doors and panels.
 11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
- B. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
 2. Other systems installed in same space as ducts.
 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- 1.6 QUALITY ASSURANCE
- A. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.
- 1.7 COORDINATION
- A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
- B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and

leakage testing of the complete duct system in whole or in part. Refer to Division 15 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

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. 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. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M, Type 304, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.

D. Tie Rods: For rectangular ducts having a side dimension of 48 inches or greater. Galvanized steel, 3/8-inch minimum diameter.

2.3 ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT

A. Manufacturers:

1. AMPCO; American Metal Products; Model IVSI-4ZC.
2. Metal-Fab Inc.; Model IPIC-3G/4G.
3. Schebler Chimney Systems; FyreGuard.
4. Selkirk Inc.; Selkirk Metalbestos; ZeroClear Z3.

B. Description: Double-wall metal vents listed according to UL 1978; with positive or negative flue pressure complying and suitable for zero-clearance installations.

C. Construction: Inner shell and outer jacket separated by a 3-inch to 4-inch annular space filled with high-temperature, ceramic-fiber insulation.

D. Inner Shell: ASTM A 666, Type 304 stainless steel.

E. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors. Seams shall be fully welded.

F. Accessories: Tees, elbows, increasers, connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as straight sections; all listed for same assembly.

1. Termination: Suitable for connection to kitchen exhaust fan.

2.4 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.

1. Manufacturers:

- a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Water-Based Joint and Seam Sealant:

1. Manufacturers:

- a. Hardcast; Flex-Grip 550 and Versa-Grip 181.
- b. Polymer Adhesives; No. 11.
- c. United McGill.

2. Application Method: Brush on.
3. Solids Content: Minimum 65 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. VOC: Maximum 75 g/L (less water).
8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 - 2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - 3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
 - 4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.6 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying 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 class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 3. Internal Tie Rod: Ducts having a side dimension of 48 inches or greater only.
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
 - 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 nonbraced panel area unless ducts are lined.
- 2.7 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION
- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
 - B. Round and Flat-Oval, Spiral Lock-Seam Ducts:
 1. Manufacturers:
 - a. Eastern Sheet Metal (ESM).
 - b. LaPine Metal Products.
 - c. Lindab Inc.
 - d. McGill AirFlow Corporation.
 - e. SEMCO Incorporated.
 - f. SET Duct Manufacturing, Inc.
 - g. Tangent Air, Inc.
 - h. Universal Spiral Air.
 - C. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

a. Manufacturers:

- 1) AccuDuct Mfg. Inc.
- 2) Ductmate Industries, Inc.
- 3) Eastern Sheet Metal (ESM).
- 4) Lindab Inc.
- 5) Universal Spiral Air.

D. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. 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 ducts.

- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 3. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 4. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 5. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 6. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
 7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 8. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
 9. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.1 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.2 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.3 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval 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, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and 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. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories."
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

1. Intermediate level.

3.4 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

- A. Install ducts to allow for thermal expansion through 2000 deg F temperature range.
- B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a

minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

- D. Install welded test ports or prefabricated test port section in the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- E. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.
- F. Field Quality Control:
 - 1. Prior to use or concealment of any portion of grease duct system, perform leakage test in presence of Code Official.
 - 2. Light test or approved equivalent test method shall be performed to determine that welded and brazed joints are liquid tight.
 - 3. Lamp shall be not less than 100 watts and shall be open to emit light equally in all directions perpendicular to duct walls.

3.5 DUCT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
 - 1. Seal Class: Refer to Application Schedule on the Drawings.
 - 2. Seal ducts before external insulation is applied.
 - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.6 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

- C. Install concrete inserts before placing concrete.
- D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
- E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

- A. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15815

SECTION 15820 - DUCT ACCESSORIES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 15 Section "Temperature Controls" for motorized control dampers.
 - 4. Division 16 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

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. 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 Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.

- 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 lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
 - F. Tie Rods: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches for use in ducts in humid or corrosive atmospheres.
 - G. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.
- 2.3 LOW PRESSURE MANUAL VOLUME DAMPERS
- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Krueger.
 - 5. Louvers and Dampers.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
 - 9. Young Regulator Company.
 - B. General Description: 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.
 - 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
 - C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total

fan volume at shutoff, and suitable for horizontal or vertical applications.

- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
 - F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 5. Tie Bars and Brackets: Galvanized steel.
 - G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
 - H. 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.
- 2.4 MOTORIZED CONTROL DAMPERS
- A. Refer to Division 15 Section "Temperature Controls."

2.5 TURNING VANES

A. Manufactured Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
4. Manufacturers:
 - a. Aero/Dyne Company; H-E-P Turning Vanes.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corp.
 - d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
3. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers:

1. ADSCO Manufacturing LLC.
2. Duro Dyne Corp.
3. Senior Flexonics Pathway.
4. Ventfabrics, 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 two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel 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.
 - E. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- 2.7 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE
- A. Manufacturers:
 - 1. Flexmaster Type 8M, UL 181, Class 1.
 - 2. Automation Industries Thermafex.
 - 3. Hart & Cooley.
 - B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
 - C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.
 - D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.8 FLEXIBLE DUCT ELBOW SUPPORTS

A. Manufacturer:

1. Automation Industries Thermaflex; FlexFlow Elbow.
2. Smart Air & Energy Solutions; SMART Flow Elbow.

B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.

C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.9 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.10 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.1 APPLICATION AND 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 PVC coated ducts; and aluminum accessories in aluminum ducts.
- C. Install volume dampers in ducts with liner in a manner that avoids damage to and erosion of duct liner.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Install fire dampers according to UL listing.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 2. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream

- from dampers and inward operation for access doors installed downstream from dampers.
3. Control devices requiring inspection.
 4. Elsewhere as indicated.
- G. Install access doors with swing against duct static pressure.
- H. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.
- I. Label access doors according to Division 15 Section "Mechanical Identification."
- J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- K. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- N. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
1. Use manufactured double-vane turning vanes unless otherwise specified.
 2. Seat outboard-most vane in heel of duct elbow.
 3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
 4. Use single-vane turning vanes in low pressure square elbows.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.

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3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

SECTION 15838 - POWER VENTILATORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Motors."
 - 3. Division 15 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. Classify according to AMCA 99.

1.3 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 thickness.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- 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. Operation and Maintenance Data: For power ventilators 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 an NRTL 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.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, 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.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

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. Belts: One set for each belt-drive unit.

PART 2 - PRODUCTS

2.1 UPBLAST CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Aerovent; a Twin City Fan Company.
 - 3. Greenheck; CUBE Series.
 - 4. Loren Cook Company.
 - 5. PennBarry; a unit of Tomkins PLC; Fumex.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide

spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
 - E. 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. Sheaves: Cast-iron, adjustable-pitch motor sheave.
 - 4. Fan and motor isolated from exhaust airstream.
 - 5. Refer to Division 15 Section "Common Work Results for HVAC" for additional requirements.
 - F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - G. Provide prefabricated roof curbs for each fan.
 - H. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- 2.2 KITCHEN HOOD EXHAUST FANS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Mfg. Corp.; Models PDURG and PNURG.
 - 2. Aerovent; a Twin City Fan Company.
 - 3. Greenheck; CUBE Series.
 - 4. JencoFan; Div. of Breidert Air Products.
 - 5. Loren Cook Company.
 - 6. PennBarry; a unit of Tomkins PLC; Fumex with Fatrap.
 - B. Description: UL 762 labeled belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, heat baffle, curb base, and accessories.

- C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains, grease collector, and drain connection.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. 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. Sheaves: Cast-iron, adjustable-pitch motor sheave.
 4. Fan and motor isolated from exhaust airstream.
 5. Refer to Division 15 Section "Common Work Results for HVAC" for additional requirements.
- F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
- G. Provide prefabricated roof curbs for each fan. Provide vented curb extension as required to locate fan discharge at a minimum of 40 inches above the roof.
- H. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- 2.3 ROOF CURBS AND ACCESSORIES
- A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. Pate.
 - c. Roof Products & Systems.
 - d. ThyCurb.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
3. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.
4. Metal Liner: Galvanized steel.

B. Roof Curb Extensions and Adapters:

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. Pate.
 - c. Roof Products & Systems.
 - d. ThyCurb.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
2. Curb Extensions: Constructed of minimum 18 ga. galvanized steel.
 - a. 4-inch high construction with no damper shelf and no damper access.
 - b. 8-inch high construction with damper shelf; and removable panel, or access door.
 - c. 12-inch high construction with damper shelf; and removable panel, or access door (minimum required for motorized damper).

2.4 MOTORS

- A. Comply with requirements in Division 15 Section "Motors."

2.5 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 07 Section "Roof Accessories" for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 15 Section "Mechanical Identification."

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.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

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RISING STARS ACADEMY at
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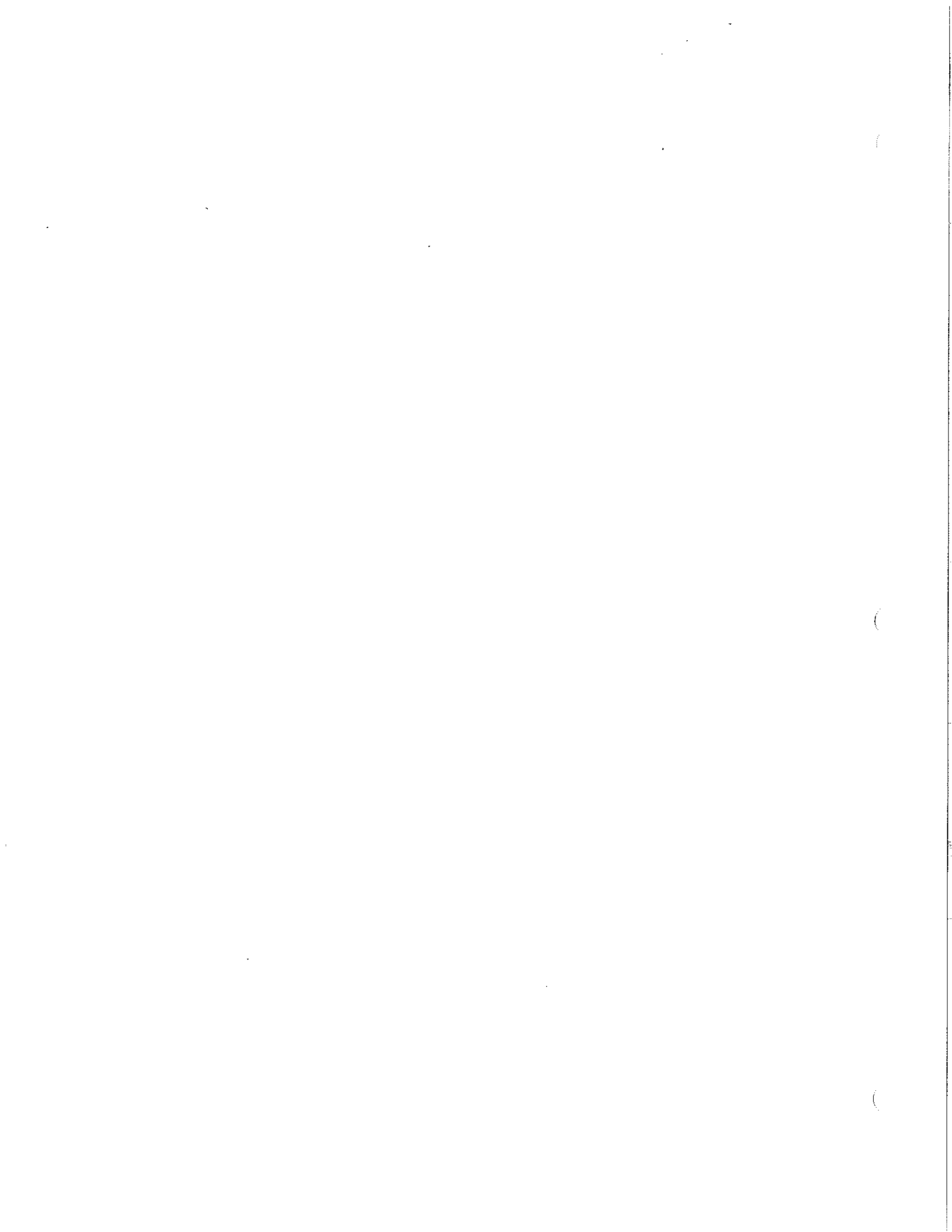
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D. Replace fan and motor sheaves as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 15838



SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

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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 "Mechanical General Requirements."
2. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Anemostat; a Mestek Company.
 - 2. Krueger; Tomkins PLC.
 - 3. Nailor Industries of Texas Inc.
 - 4. Price Industries.
 - 5. Titus; Tomkins PLC.
 - 6. Tuttle & Bailey; Tomkins PLC.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Provide plaster frames for units installed in plaster ceilings.
- D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
- E. Air diffusion devices shall be standard off white baked enamel finish unless noted otherwise. Provide air diffusion device interior surfaces, including blank-offs, with black matte finish.
- F. Air pattern adjustments shall be made from the face of the device.
- G. Refer to drawings and schedules for quantities, types, and finishes.
- H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space

Sound Levels in the Application of Air Terminals and Air
Outlets."

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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

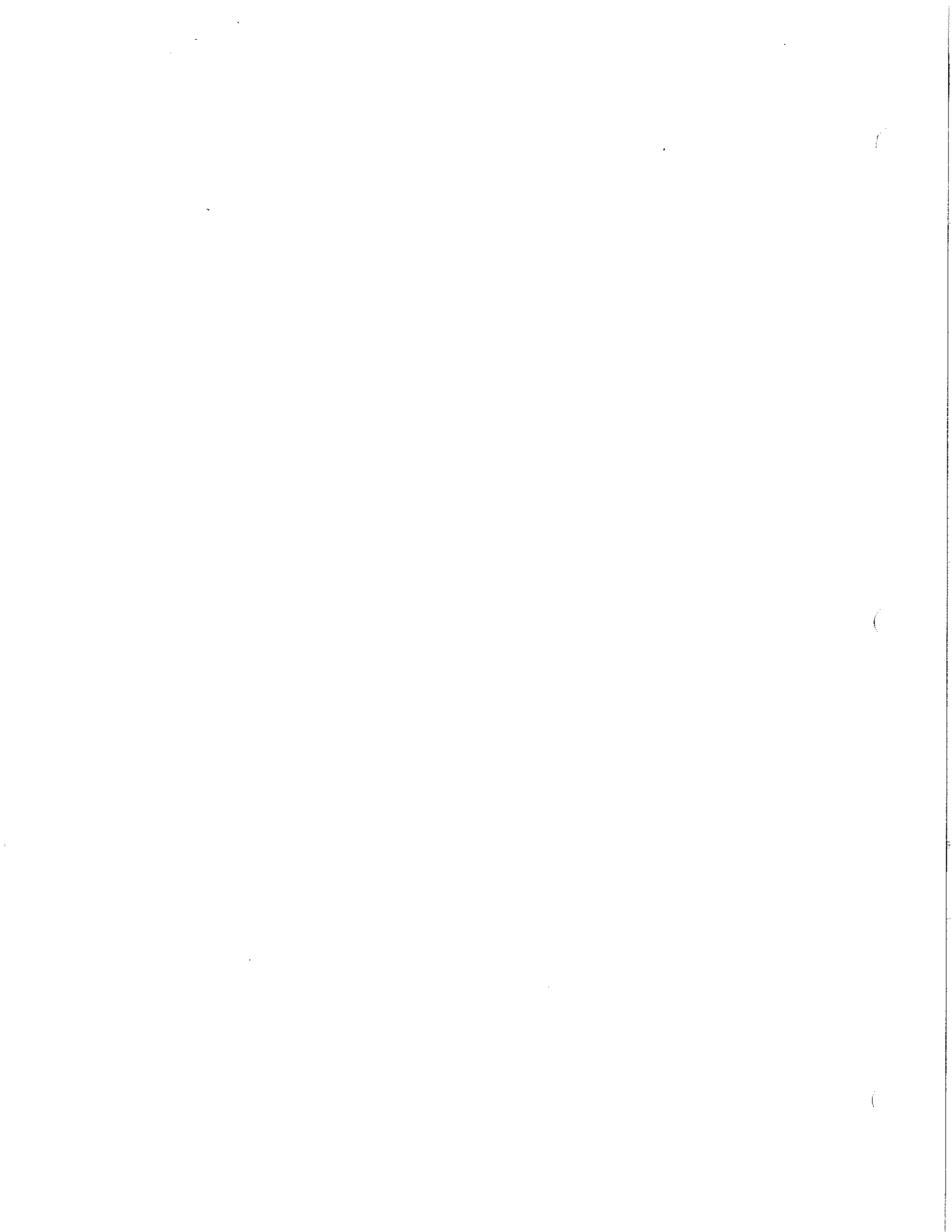
3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: 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 panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855



SECTION 15860 - ENVIRONMENTAL EQUIPMENT

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 15 Section "Mechanical General Requirements."
 - 2. Division 15 Section "Basic Mechanical Materials and Methods."
 - 3. Division 15 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 REFERENCES

- A. Standards referenced in this Section:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
3. AMCA 99 - Standards Handbook.
4. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
5. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
6. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
7. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
8. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
9. ANSI/AHRI 430 - Central Station Air Handling Units.
10. ANSI/AHRI 440 - Performance Rating of Room Fan-Coils.
11. NEMA MG1 - Motors and Generators.
12. NFPA 70 - National Electrical Code.
13. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
14. ANSI/UL 586 - Test Performance of High Efficiency Particulate Air Filter Units.
15. ANSI/UL 900 - Test Performance of Air Filter Units.
16. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
17. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance-Test Methods.
18. UL Standard 1995 - Standard for Heating and Cooling Equipment.

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. Filters: Filter performance data, filter assembly, and filter frames.
- C. 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. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wiring Diagrams: Power, signal, and control wiring.

D. Field quality-control test reports.

E. Start-up reports.

F. Operation and Maintenance Data: For environmental equipment to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Air handling units shall be ETL listed to UL Standard 1995.

B. Filters:

1. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2, as approved by local authorities.
2. Provide all filters as product of one manufacturer.
3. Assemble filter components to form filter banks from products of one manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

D. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place,

bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

- A. Provide one set of fan belts for each fan.
- B. Provide one additional set of each filter type for each unit, to be installed at project closeout.

PART 2 - PRODUCTS

2.1 PACKAGED INDIRECT-FIRED GAS MAKE-UP AIR UNITS

- A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, and indirect-fired gas furnace to be installed outside the building.
- B. Cabinet: Double-wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Cabinet shall be fully weatherized for outside installation.
- C. Access Panels: Lift-out or piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.
- D. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on complete unit.
 - 1. Thickness: 1 inch.
 - 2. Insulation Adhesive: Comply with ASTM C 916, Type I.
 - 3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.
- E. Finish: Heat-resistant, baked enamel.
- F. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft.
- G. Motor: Refer to Division 15 Section "Motors."

- H. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.
- I. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with elastomeric isolators.
- J. Outdoor-Air Hood: Galvanized steel with rain baffles, bird screen, and finish to match cabinet; and sized to supply maximum 100 percent outdoor air.
- K. Disposable Panel Filters: 1-inch-thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames.
 - 1. Media: Interlaced glass fibers.
 - 2. Frame: Galvanized steel.
- L. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg.
- M. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.
- N. Indirect-Fired Gas Furnace: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and NFPA 54, "National Fuel Gas Code."
 - 1. CSA Approval: Certified by and bearing label of CSA International.
 - 2. Burners: Stainless steel.
 - a. Gas Control Valve: Modulating.
 - b. Fuel: Natural gas.
 - c. Minimum Thermal Efficiency: 80 percent.
 - d. Ignition: Electronically controlled electric spark with flame sensor.
 - 3. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
 - 4. Heat Exchanger: Stainless steel.
 - 5. Heat-Exchanger Drain Pan: Stainless steel.
 - 6. Safety Controls:

- a. Gas Train: Control devices and control sequence shall comply with ANSI standards and GE GAP/IRI.
- b. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
- c. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
- d. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
- e. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
- f. Control Transformer: 24-V ac.

O. Controls:

1. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
2. Control Panel: Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:
 - a. On-off-auto fan switch.
 - b. Supply-fan operation indicating light.
 - c. Heating operation indicating light.
 - d. Thermostat.
 - e. Damper position potentiometer.
 - f. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
 - g. Safety-lockout indicating light.
3. Fan Control: Interlock fan to start with exhaust fan(s).
 - a. Smoke detectors, located in supply air, shall stop fans when the presence of smoke is detected.
4. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
5. Mixed Outdoor- and Return-Air Damper Control: When fan is running, outdoor- and return-air dampers shall modulate to supply minimum outdoor air as follows:

- a. Minimum 30 percent outdoor air.
 - b. Outdoor-air quantity adjusted by potentiometer on control panel.
 - c. Outdoor-air quantity to maintain minimum building static pressure.
6. Temperature Control: Operates gas valve to maintain supply-air temperature.
- a. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
 - b. Furnace Control: 20 to 100 percent modulation of the firing rate. 10 to 100 percent with dual furnace units.

P. Accessories:

1. Service Outlets: 115-V, ground-fault, circuit-interrupter type, factory wired such that outlet shall remain energized even if the unit main disconnect is open.

Q. Roof Curb: Manufacturer's standard, full-perimeter curb of sheet metal, with wood nailer, neoprene sealing strip, and welded Z-bar flashing. Top of curb shall be level and extend a minimum of 10 inches above top of roof insulation.

R. Manufacturers:

1. Greenheck; Model IGX.
2. Modine Manufacturing Company.
3. Rapid Engineering, Inc.
4. Reznor-Thomas & Betts Corporation; Mechanical Products Division; Model RDH.

2.2 ROOF CURBS

A. Provide prefabricated roof curbs where indicated. Coordinate installation and type with Architectural Trades. Top of curb shall be level and extend a minimum of 10 inches above top of roof insulation.

1. Manufacturers:
 - a. Pate.

- b. Thycurb.
- c. Roof Products and Systems.
- d. Greenheck.
- e. Creative Metals.
- f. Any of the approved rooftop equipment manufacturers.

2.3 FILTER GAUGES

- A. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-2.0 inch WG, 2 percent of full scale accuracy.
- B. Manufacturer:
 - 1. Dwyer Magnehelic.
- C. Provide filter gauges across each filter bank.

2.4 WATERPROOFING

- A. Materials for the system specified consist of: Primer-sealer; neoprene base coating with continuous roving glass fiber reinforcing if standard with the manufacturer; neoprene wearing course with granules; Hypalon weathering and color coating; reinforcing materials, sealant and flashing compounds and sheet flashing, all compatible with the basic materials as required for a complete installation. Coating color shall be as selected by the Architect from the manufacturer's standard colors.
- B. Manufacturers:
 - 1. Gaco Western; Gacoflex.
 - 2. Autodeck; Neoprene-Hypalon Wear Membrane.
 - 3. Neogard Corp.; Pedagard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish, install and apply equipment and materials in accordance with the manufacturer's published instructions, and approved shop Drawings.

- B. Install central station air handling units in accordance with manufacturer's recommended procedures.
- C. Hoist, transport, and rig air handling units or their shipping sections into position following procedures recommended by the manufacturer.
- D. Replace filters in each unit at time of project final acceptance. Refer to Division 15 Section "Mechanical General Requirements" for additional information.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections.
- B. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Division 15 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts.
- D. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 16 Section "Grounding and Bonding."
- 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 LUBRICATION

- A. Lubricate equipment and fill lubrication systems per manufacturer's published instructions.

3.4 FIELD QUALITY CONTROL

- A. Perform tests in accordance with manufacturer's published data.

3.5 START-UP SERVICE

- A. Provide a field Engineer for start-up of factory fabricated, built-up air handling and exhaust units. Field Engineer shall provide start-up service for temporary construction use, final inspection and adjustment of the units. Include labor, materials, travel, per diem and any other costs as part of the "Field Engineer" work.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Refer to Division 15 Section "Mechanical General Requirements." Provide copies of operation and maintenance manuals as specified.

END OF SECTION 15860

SECTION 15900 - TEMPERATURE CONTROLS

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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 work of this section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."

2. Division 15 Section "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. BAS: Building Automation System
- B. CAD: Computer Aided Design.
- C. DDC: Direct-digital controls.
- D. TC: Temperature Control.

1.4 SYSTEM DESCRIPTION

- A. Temperature control building automation system consisting of direct digital control system panels, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
- B. BAS/DDC system programming, database and graphic display generation at the remote operator workstation.
- C. Electric thermostats, control valves, dampers, operators, control wiring, etc.
- D. Gauges, indicating devices, electric and electronic control accessories, and other control system devices.

1.5 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

- A. Submit under Division 15 provisions of respective project and as supplemented in this section.

- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. 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.
1. Each control device labeled with setting or adjustable range of control
- D. 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.
- E. Shop Drawings:
1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 4. Details of control panel faces and interior, including controls, instruments, termination blocks and labeling.
 5. Written sequence of operation for each controlled system.
 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 8. Complete bill of materials to identify and quantify all control components
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

- G. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- H. Project Record Documents: Include the following:
 - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
 - 2. Record actual locations of control components, including control units, thermostats, and sensors.
- I. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.7 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- F. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- G. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
- H. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- I. NEMA DC 3 - Low-Voltage Room Thermostats.

J. ASTM E1 - Specification for ASTM Thermometers.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- 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 NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 15 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.

- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Coordinate equipment with Division 13 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 15 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

- A. Provide warranty per Division 15 Section "General Mechanical Requirements" and as supplemented in this section.
- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

1.12 POSTED OPERATING INSTRUCTIONS

- A. Provide panel related as-built documents in protective binder or clear plastic display envelope for each control panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance.

1.14 PROTECTION OF PROPRIETARY INFORMATION

- A. All proprietary manuals and software shall be subject to a non-disclosure agreement, to be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 - PRODUCTS

2.1 DDC PANEL LOCAL DISPLAY AND KEYPAD

- A. Provide a display and keypad built-in to the face of DDC panels located in major mechanical rooms.
- B. The local display and keypad shall allow the operator to read point values and/or point status, adjust setpoints and/or parameters, and display point and alarm information.
- C. The display shall have a minimum 24 character capability. Keypad operation shall be menu driven.
- D. Use of the local display and keypad shall not interfere with normal data communication network operation nor with the normal operation of the connected DDC panel.

2.2 DDC INPUT/OUTPUT SENSORS

- A. Air Static/Differential Pressure Transmitters:
 - 1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
 - 2. Safe overpressure rating shall be minimum 5 times the range.
 - 3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
 - 4. Accuracy: One percent of full scale.
 - 5. Manufacturers:
 - a. Dwyer.

- b. Setra.
- c. Modus.
- d. Air Monitor.

2.3 DAMPER OPERATORS - ELECTRIC

- A. Electric damper motor shall be 24 or 120 volt two position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.
- B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
- C. Manufacturers:
 - 1. Belimo.
 - 2. Delta Control Products.
 - 3. Honeywell.
 - 4. Invensys.
 - 5. Johnson Controls.
 - 6. Siemens.

2.4 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 16 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 16 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

2.5 LIMIT SWITCHES

- A. Oil tight type with operator as required to provide required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- B. Manufacturers:
 - 1. Allen-Bradley.
 - 2. General Electric.
 - 3. Square D.
 - 4. Westinghouse.
 - 5. Micro-switch.

2.6 LOCAL AND AUXILIARY CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.7 THERMOMETERS - AIRSTREAM

- A. ASTM E1, 4 inch diameter dial in stainless steel or drawn steel with enamel finish case, vapor or liquid actuated

with brass or copper bulb, copper or bronze braided capillary of sufficient length and with necessary bulb supports within airstream, white with black markings and black pointer, unbreakable lens, 1 percent scale accuracy. Maximum scale divisions shall be 2 deg F. Select scale ranges such that all expected temperatures are within the range but such that the range does not extend beyond the extremes more than 25 degrees.

B. Manufacturers:

1. Trerice.
2. Weksler.
3. Marsh.
4. Honeywell.
5. Invensys.
6. Johnson Controls.
7. Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
- E. Provide conduit and electrical wiring where required.
- F. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.

- G. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- H. Coil and conceal excess capillary on remote element instruments.
- I. Install thermometers in air duct systems on flanges.
- J. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.
- K. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- L. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- M. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
- N. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- O. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- P. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

- Q. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 60 seconds.

3.2 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each control panel, field device, and splice.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached identifying it as control panel number, system served, area served, fed from lighting panel number, circuit number, etc.

3.3 OWNER INSTRUCTION AND TRAINING

- A. Provide a minimum of eight (8) of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

3.4 CALIBRATION AND START-UP

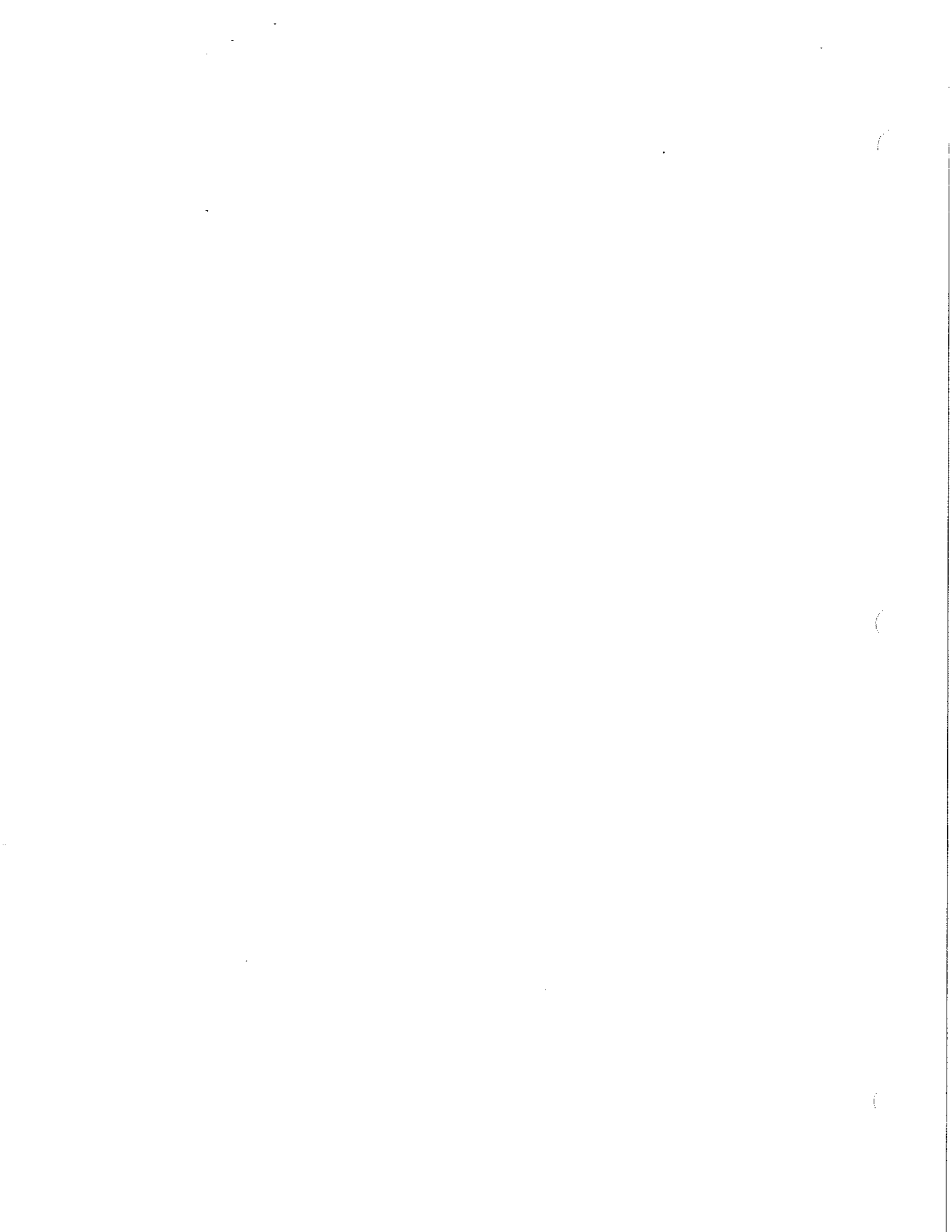
- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.5 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 15900



SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

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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 "Mechanical General Requirements."
2. Division 15 Section "Basic Mechanical Materials and Methods."
3. Division 15 Section "Common Work Results for HVAC."

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 2. HVAC equipment quantitative-performance settings.
 3. Kitchen hood airflow balancing.
 4. Existing systems TAB.
 5. Verifying that automatic control devices are functioning properly.
 6. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

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. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. 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.
- E. 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.
- F. NC: Noise criteria.

- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. 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.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. 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.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. 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. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within [30] [60] [90] days from Contractor's Notice to Proceed, submit [2] [4] [6] copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Approved Balancing Agencies.

- 1. The TAB firm selected shall be from the following list:

- a. Absolut Balance Company, Inc.; South Lyon, MI.
- b. Aerodynamics Inspecting Company; Dearborn, MI.
- c. Airflow Testing Inc.; Lincoln Park, MI.
- d. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
- e. Ener-Tech Testing; Holly, MI.
- f. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
- g. International Test & Balance Inc.; Southfield, MI.

- C. 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.

- D. 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." TAB firm's forms approved by Architect.

E. 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."

F. 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. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes 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.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB 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 system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. 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.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

- F. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- G. Examine equipment for installation and for properly operating safety interlocks and controls.
- H. 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. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at indicated values.
 - 8. Interlocked systems are operating.
 - 9. Changeover from heating to cooling mode occurs according to indicated values.
- I. 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. Perform the following field tests and inspections to new and renovated portions of duct systems according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system

at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 6. 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" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

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, or use reduced scale contract documents with notations.

- 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. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
 - F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
 - G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - H. Verify that motor starters are equipped with properly sized thermal protection.
 - I. Check dampers for proper position to achieve desired airflow path.
 - J. Check for airflow blockages.
 - K. Check condensate drains for proper connections and functioning.
 - L. Check for proper sealing of air-handling unit components.
 - M. 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.
 - 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 such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 15 Section "Common Work Results for HVAC" for additional requirements.
 5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 15 Section "Common Work Results for HVAC" for additional requirements.
 6. Do not recommend 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, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
 - a. Where sufficient space in submain 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.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. 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. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 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. Power factor.
 6. Nameplate and measured voltage, each phase.
 7. Nameplate and measured amperage, each phase.
 8. Starter size.

9. Starter thermal-protection-element rating.
10. Fuse number and size.

- 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.

3.7 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.

3.8 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.

3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.
- 3.9 PROCEDURES FOR EXHAUST HOODS
- A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.
- B. After balancing is complete, do the following:
1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum results.
- 3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction 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. 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.
 3. Air balance each air outlet.
- 3.11 TOLERANCES
- A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow

rates if overall room supply is within plus or minus 5 percent.

3.12 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.

3.13 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. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. 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. Notes to explain why certain final data in the body of reports varies from indicated values.
14. 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. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Inlet vane settings for variable-air-volume systems.
 - f. Settings for supply-air, static-pressure controller.
 - g. 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 flow rates.
 3. Terminal units.
 4. Balancing stations.
- 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.
 - g. Power factor efficiency.
 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. Heating coil static-pressure differential in inches wg.
 - g. Outside airflow in cfm.
 - h. Return airflow in cfm.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btuh.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btuh.
- i. High-fire fuel input in Btuh.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btuh.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btuh.

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. Round, Flat-Oval, and Rectangular 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. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.14 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 room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

- c. Verify that balancing devices are marked with final balance position.
- d. 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 Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. 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."
5. 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.
6. 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.
7. 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.

3.15 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.

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- 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 16010 - ELECTRICAL GENERAL REQUIREMENTS

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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 work of this section.

1.2 SUMMARY

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 REFERENCES

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. A.N.S.I. - American National Standards Institute
2. A.S.T.M. - American Society for Testing Materials
3. I.C.E.A. - Insulated Cable Engineers Association
4. I.E.E.E. - Institute of Electrical and Electronics Engineers
5. N.E.C. - National Electrical Code
6. N.E.C.A. - National Electrical Contractors Association
7. N.E.M.A. - National Electrical Manufacturer's Association
8. U.L. - Underwriters Laboratories, Inc.
9. N.E.C.A. 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."

1.4 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 16 Sections and as indicated on Drawings.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or

Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.

- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.5 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction

in excess of code requirements, the Drawings and/or Specifications shall govern.

1.6 DRAWINGS

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.

- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

1.8 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

- 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall

fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- D. Submit for approval shop drawings for electrical systems or equipment listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical Specifications for additional requirements.

1. Panelboards
2. Motor Control
3. Wiring Devices
4. Lighting Fixtures
5. Lighting Control
6. Fire Alarm Devices

1.11 COORDINATION DRAWINGS

- A. Submit project specified coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.

- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

- C. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

1. Routine maintenance procedures.
2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
3. Trouble-shooting procedures.
4. Contractor's telephone numbers for warranty repair service.
5. Submittals.
6. Recommended spare parts lists.
7. Names and telephone numbers of major material suppliers and subcontractors.
8. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 1.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or mylar which have been

neatly marked to represent as-built conditions for all new electrical work.

- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 16 sections, refer specifically to section 16511 "Interior Lighting") from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

- B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.
- C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 DEMOLITION WORK

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

3.2 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.3 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be

interrupted at such time as will be designated by the Owner's Representative.

- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.4 TEMPORARY SERVICES

- A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 1, a complete temporary electrical and telephone service during construction.

3.5 DISPOSAL

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.
3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
 2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
 3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
 4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.
- 3.6 CHASES AND RECESSES
- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.
- 3.7 CUTTING, PATCHING AND DAMAGE TO OTHER WORK
- A. Refer to General Conditions for requirements.
 - B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.
- 3.8 EXCAVATION AND BACKFILLING
- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
 - B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4"

minimum coverage, all around or as shown on the electrical Drawings.

- C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- D. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.9 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, motors, elevator controllers, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.10 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture

reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.11 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.12 EXTRA WORK

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, data box, V4000 wiremold, fire alarm horn/strobe, fire alarm strobe, P.A. speaker, clock, or other devices which may be required for any proposed extra work.

3.13 DRAWINGS AND MEASUREMENTS

- A. These Specifications and accompanying Drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor understands that the work herein described shall be complete in every detail.
- B. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field

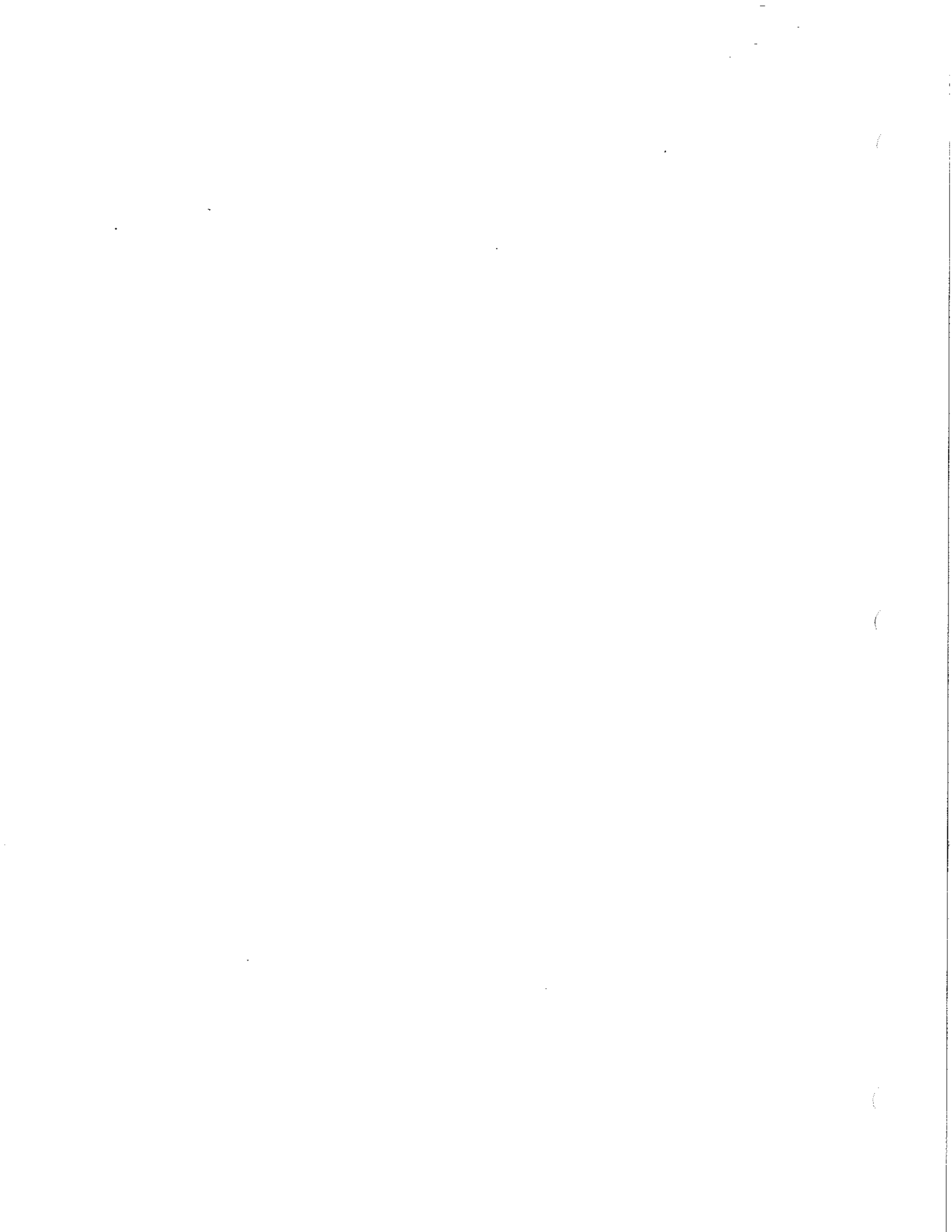
CENTER LINE PUBLIC SCHOOLS
RISING STARS ACADEMY at
MILLER ELEMENTARY SCHOOL

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MARCH 11, 2013

measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION 16010



SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

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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 and communications installation requirements.
 - 4. Grout.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.

1.4 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.5 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 and provide access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8.
- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the 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. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. 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.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL AND COMMUNICATIONS 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 AND COMMUNICATIONS PENETRATIONS

- A. Electrical penetrations occur when raceways, cables or wireways, 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.
- 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. 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.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. 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.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

- I. 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.
- J. 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.
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. 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.
- M. 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.

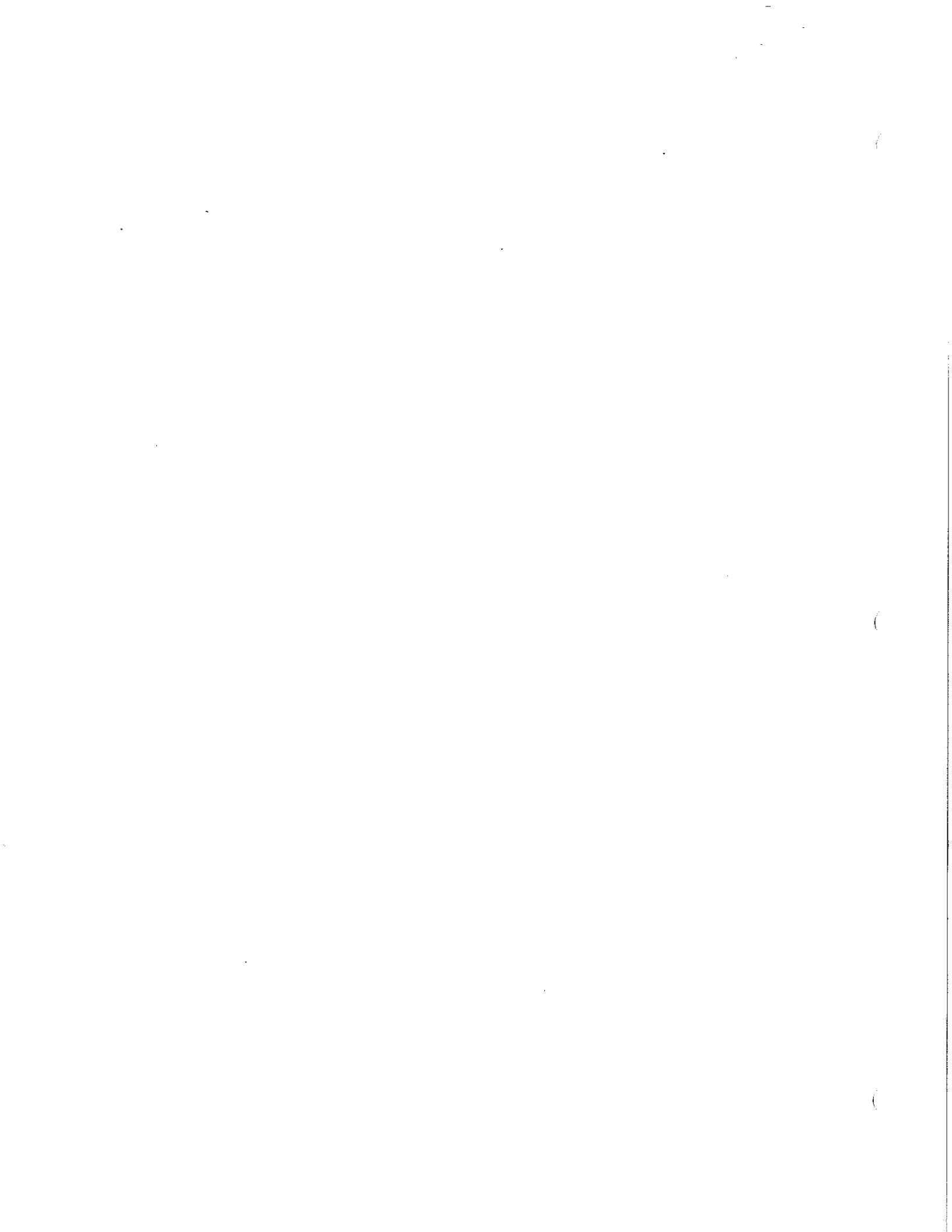
3.3 FIRESTOPPING

- 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.

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



OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC FLASH STUDY

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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 work of this section.

1.2 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D prepared by the electrical equipment manufacturer.

- C. The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 - Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 - Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 - Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 -National Electrical Code, latest edition

2. NFPA 70E - Standard for Electrical Safety in the
Workplace

1.4 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.5 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Five (5) bound copies of the complete final report shall be submitted. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
- B. The contractor is required to provide the study project files to the Owner in electronic format. In addition, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the Owner to review all aspects of the project and print arc flash labels, one-line diagrams, etc.
- C. The report shall include the following sections:
1. Executive Summary.
 2. Descriptions, purpose, basis and scope of the study.
 3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
 4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.

6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.

D. Arc flash labels shall be provided in hard copy and a copy of the computer analysis software viewer program is required to provide arc flash labels in electronic format.

1.6 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.7 COMPUTER SOFTWARE PROGRAMS

- A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:
 1. EDSA Micro Corporation.
 2. SKM Systems Analysis, Inc.
 3. ESA Inc.
 4. CGI CYME.
 5. Operation Technology, Inc.

PART 2 - PRODUCTS

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.

2.2 DATA COLLECTION

- A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated
4. Source impedance data, including electric utility system and motor fault contribution characteristics
5. Tabulations of calculated quantities
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point
2. Incoming switchgear
3. Unit substation primary and secondary terminals
4. Low voltage switchgear
5. Motor control centers
6. Standby generators and automatic transfer switches
7. Branch circuit panelboards
8. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device
 - 2. Medium voltage equipment overcurrent relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 - 6. Conductor damage curves
 - 7. Ground fault protective devices, as applicable
 - 8. Pertinent motor starting characteristics and motor damage points, where applicable
 - 9. Pertinent generator short-circuit decrement curve and generator damage point
 - 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will

typically decay from 10 per unit to 3 per unit after 10 cycles).

- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
 - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 - 3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance ($X''d$),

- rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:
1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance
 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Calculated asymmetrical fault currents
 - 1) Based on fault point X/R ratio
 - 2) Based on calculated symmetrical value multiplied by 1.6
 - 3) Based on calculated symmetrical value multiplied by 2.7
 - e. Equivalent impedance
 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage

- b. Calculated symmetrical fault current magnitude and angle
- c. Fault point X/R ratio
- d. No AC Decrement (NACD) Ratio
- e. Equivalent impedance
- f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
- g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:

- a. Current transformer ratio
- b. Current setting
- c. Time setting
- d. Instantaneous setting
- e. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

- a. Adjustable pickups and time delays (long time, short time, ground)
- b. Adjustable time-current characteristic
- c. Adjustable instantaneous pickup
- d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations

1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

- A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify design engineer in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

- A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

CENTER LINE PUBLIC SCHOOLS
RISING STARS ACADEMY at
MILLER ELEMENTARY SCHOOL

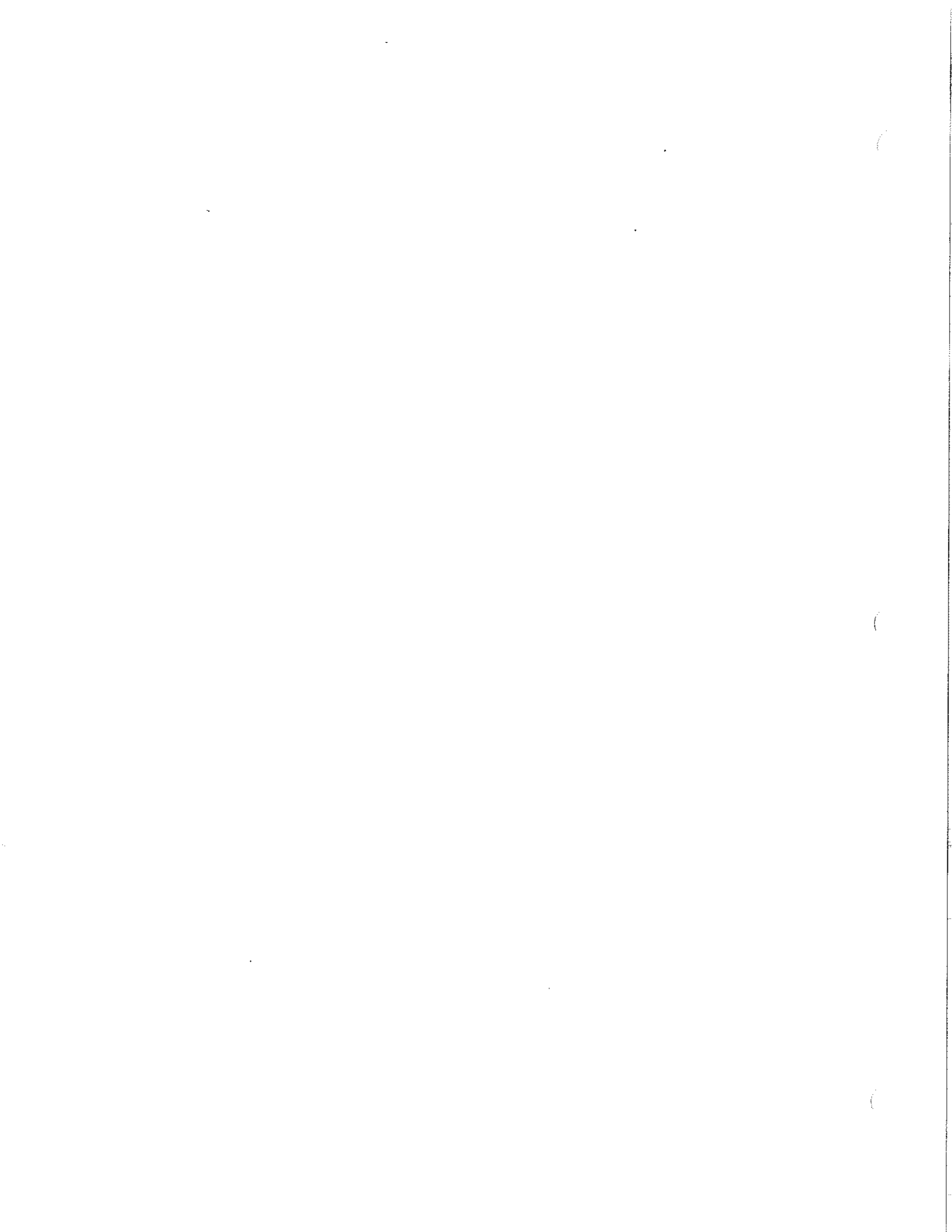
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1. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one flash label shall be provided.
5. For medium voltage switches one arc flash label shall be provided

F. Labels shall be field installed by the contractor.

END OF SECTION 16055



SECTION 16060 - GROUNDING AND BONDING

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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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

- C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- G. IEEE 1100 - 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- H. IEEE C2: National Electrical Safety Code.
- I. NETA MTS - 2001: Maintenance Testing Specifications.
- J. NFPA 70: National Electrical Code.
- K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- L. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- M. UL 467: Grounding and Bonding Equipment.
- N. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- O. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.4 SUBMITTALS

- A. Field Test Reports: Submit written test reports to include 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.
 - 4. Indicate overall system resistance to ground.

5. Indicate overall Telecommunications system resistance to ground.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 16 "Electrical General Requirements".
- B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."
- 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.
 1. Comply with UL 467.
- C. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".
- D. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Grounding Conductors and Cables:
 - a. Refer to Division 16 Section "Conductors and Cables".
 2. Grounding Rods:

- a. American Electric-Blackburn.
- b. Apache Grounding/Erico Inc.
- c. Chance/Hubbell.

3. Mechanical Connectors:

- a. American Electric-Blackburn.
- b. Burndy.
- c. Chance/Hubbell.

4. Exothermic Connections:

- a. Cadweld.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: Aluminum with feeder cable only, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Copper, stranded cable.
- E. Underground Conductors: Bare, stranded, copper unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
 1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.

- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
- D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
 - 1. Size: 5/8 (16 mm) in diameter.
 - 2. Length: 120 inches (3000 mm).

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

- D. In raceways, use insulated equipment grounding conductors.
- E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- I. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.2 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except

those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding 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.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.3 INSTALLATION

- A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:
 1. Ground rods.
 2. Metal water service pipe.

- B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
1. Verify that final backfill and compaction has been complete before driving ground rods.
 2. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
- D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- G. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.

H. Grounding Bus:

1. Install grounding bus in the locations listed below and elsewhere as indicated:
 - a. Electrical equipment rooms.
 - b. Telephone equipment rooms.
 - c. Rooms housing service equipment.
2. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

- I. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing"
1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
 2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground

impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.

- d. Equipment Grounds: Utilize two-point method of IEEE 81. Measure between equipment ground being testing and known low-impedance grounding electrode or system.

- 3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.5 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 16060

SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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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.
 - 2. Construction requirements for concrete bases.

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 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section.

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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.

- e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. 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 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.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Empire Tool and Manufacturing Co., Inc.
 - c. Hilti Inc.
 - d. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. 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 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 in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support 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 two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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.
- D. 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: 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

- F. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- G. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- H. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- I. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- J. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- K. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- L. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- M. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section 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 CONCRETE BASES

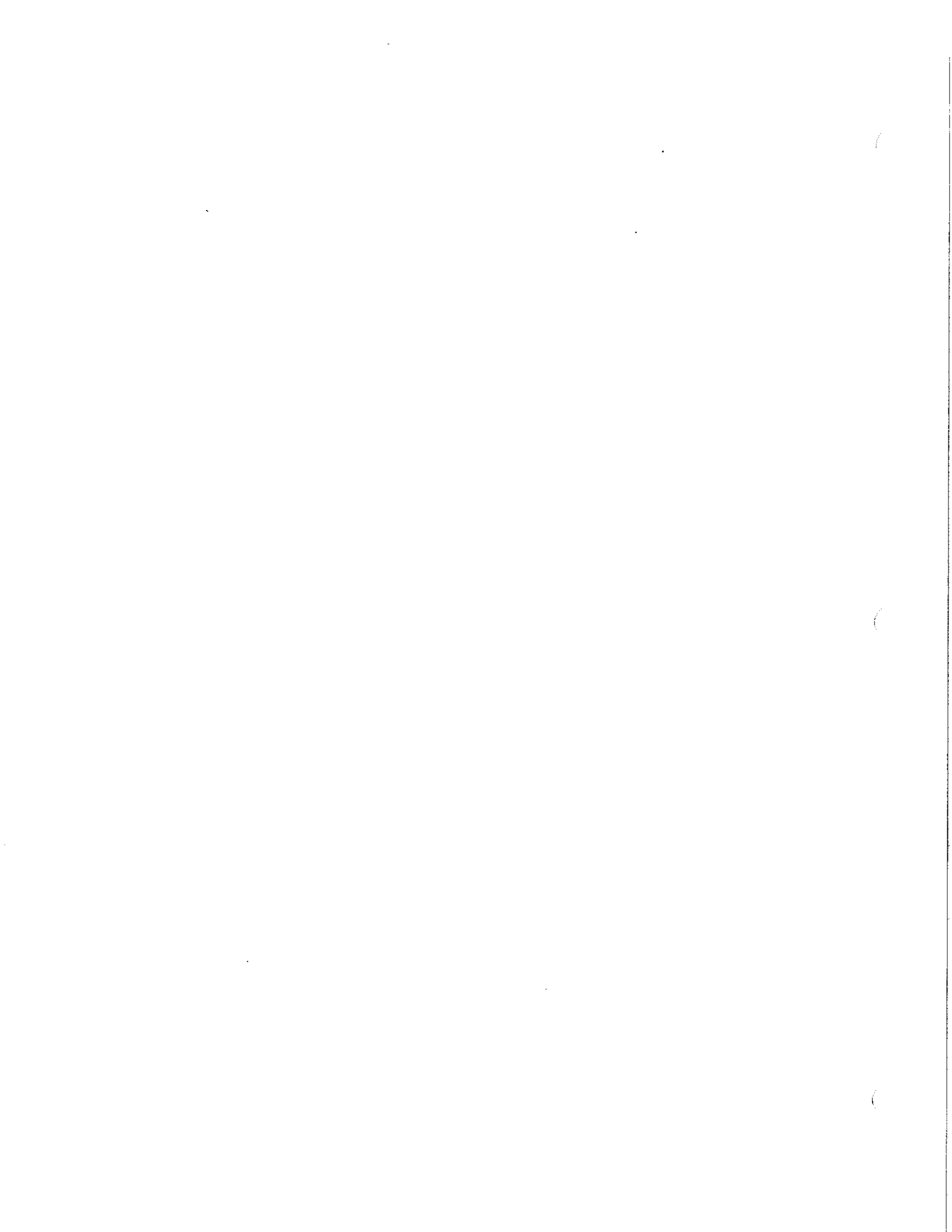
- A. Provide concrete bases for all floor mounted electrical equipment.

- B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.
- C. Base/Pad Construction:
 - 1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
 - 2. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
 - 3. Construct concrete bases for packaged engine generator per manufacturer's requirements.
- D. Anchor equipment to base per both supports and equipment manufacturer's instructions.
- E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

3.5 PAINTING

- A. Touchup: 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.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 9 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. 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 16075 - ELECTRICAL IDENTIFICATION

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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 raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 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 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR, 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. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 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. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch (10 mm).
- B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 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. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.7 WIRING DEVICE IDENTIFICATION

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 100 A: Identify with self-adhesive vinyl tape applied in bands.
 - 1. 480Y/277V Systems: Orange.
 - 2. 208Y/120V Systems: Green.

- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
1. Fire Alarm System: Red.
 2. Security System: Blue.
 3. Telecommunication System: Yellow.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 2 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- E. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- G. 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.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install

underground-line warning tape for both direct-buried cables and cables in raceway.

- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 2. 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.
- J. 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: Mechanically secured, engraved, laminated acrylic or melamine label. Labels shall be 2 1/2" high x 4 1/2" wide. Provide 3 lines of text. Line one shall have 1/2" letters spaced 1/2" down from top of label. Lines 2 and 3 shall have 1/4" letters. Each line shall be spaced 1/4" apart.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. 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. Electrical switchboards.
- d. Transformers.
- e. Emergency system boxes and enclosures.
- f. Disconnect switches.
- g. Enclosed circuit breakers.
- h. Motor starters.
- i. Push-button stations.
- j. Power transfer equipment.
- k. Contactors.
- l. Remote-controlled switches, dimmer modules, and control devices.
- m. Power-generating units.
- n. Voice and data cable terminal equipment.
- o. Master clock and program equipment.
- p. Intercommunication and call system master and staff stations.
- q. Television/audio components, racks, and controls.
- r. Fire-alarm control panel and annunciators.
- s. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- t. Monitoring and control equipment.
- u. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- v. Breakers at distribution panels.

- K. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location:

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 2. Conduit Markers: Provide identification for each power conduit 1¼ inches or larger.
- 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. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, 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.
5. 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.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade.
- J. Label information arrangement for 3 lines of text.
1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.

K. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100
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- L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- M. Degrease and clean surface to receive nameplates.

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- N. Install nameplate and labels parallel to equipment lines.
- O. Secure nameplate to equipment front using screws.
- P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- Q. Identify conduit using field painting where required.
- R. Paint red colored band on each fire alarm conduit and junction box.
- S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS AND CABLES

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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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to Specification Section "Electrical Testing."
- 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

1. Triangle.
2. Royal.
3. Rome.
4. General Cable Corporation.
5. Southwire Company.
6. Draka USA.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper.

D. Conductor Insulation Types: Type THHN-THWN, XHHW and SO complying with NEMA WC 70.

E. Multiconductor Cable: Metal-clad cable, Type MC and Type SO with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

6. T & B.
7. Burndy.
8. ILSCO.

- 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 AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway and metal-clad cable, Type MC.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway and metal-clad cable.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway and metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway and metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- I. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

- 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 "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7.
- G. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- H. All wiring shall be installed in conduit or approved raceway. All raceways shall be provided with a ground conductor unless noted otherwise on the Contract Documents.
- I. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾"C.
- J. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.
- K. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- L. Use suitable cable fittings and connectors.

- M. Neatly train and tie wrap wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- R. Branch circuits may be combined up to 6 circuits in a homerun conduit. Electrical Contractor shall be responsible for derating of conductors as required by N.E.C.
- S. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger.
- T. Type MC cable shall be supported and secured at intervals not exceeding 4'-0". Where MC cable is fished into concealed spaces such as walls, no support is required in these areas.
- U. Fittings used for MC cable shall be identified for such use.
- V. MC cable shall not be used for home runs to receptacle or distribution panels.
- W. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

3.3 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.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing"
 - 1. Description: Test all feeders rated 100 A and above.
 - 2. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.
 - 3. Electrical Tests
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 4. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mehogms.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

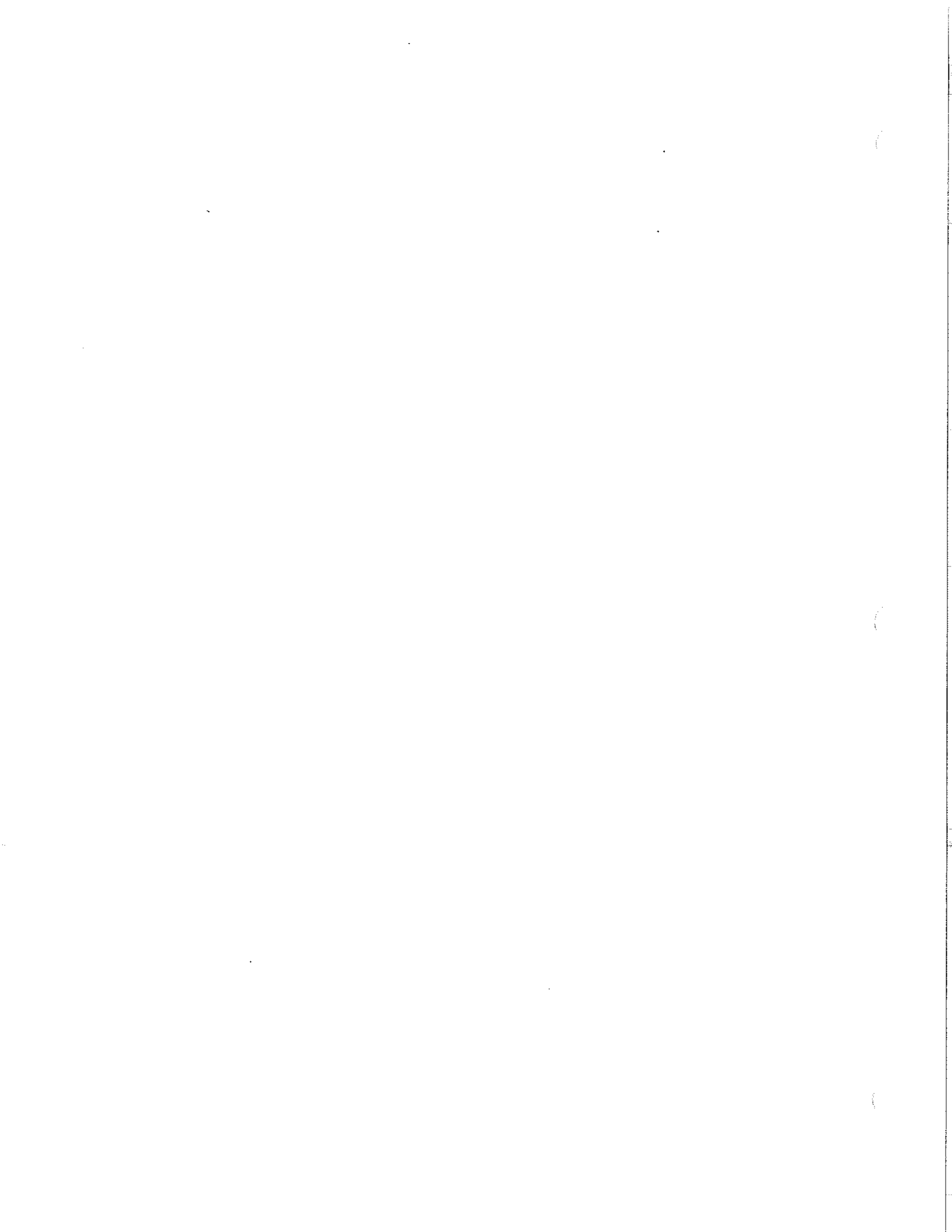
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3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120



SECTION 16130 - RACEWAYS AND BOXES

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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, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.

- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

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 NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube Triangle Century.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. International Metal Hose.
 - 6. Electri-Flex Co

7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company -
Manhattan/CDT/Cole-Flex.
9. Maverick.
10. O-Z Gedney; unit of General Signal.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw type.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiralduct, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Manufacturers:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

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. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

1. Manufacturers:

- a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
- b. Thomas & Betts Corporation.
- c. Walker Systems, Inc.; Wiremold Company (The).
- d. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Floor Boxes: Nonmetallic, nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors Applications:
 - 1. Exposed: Rigid steel or IMC.
 - 2. Concealed: Rigid steel or IMC.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoor Applications:

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 up to 10'-0" above finished floor. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Mechanical boiler rooms.
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. Raceways Embedded in Concrete Above Grade: EMT or Rigid Steel.
8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
10. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations, and type 4, stainless steel in kitchen areas.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. EMT: Use steel set screw conduit fittings.
2. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
3. Rigid Steel Conduits: Use only fittings approved for use with that material.

- E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

- A. Install conduit in accordance with NECA "National Electrical Installation Standards".
- B. Keep raceways at least 6 inches 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. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- I. Raceways Embedded in Slabs:
 - 1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
 - 2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 4. Space raceways laterally to prevent voids in concrete.
 5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 6. Conduits shall run flat. Do not allow conduits to cross.
- J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- K. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.
- L. Tighten set screws of threadless fittings with suitable tools.
- M. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

- O. Provide pull string and 25% spare capacity in every branch circuit conduit.

- P. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
 - 1. Electrical conduit (LB's) are not permitted.
 - 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
 - 3. Conduits shall contain no continuous sections longer than 100 ft. without a pull point/box.
 - 4. The bend radius of conduit must be at least 6 times the internal diameter for a conduit 2 inches or less and a radius of 10 times the diameter for a conduit greater than two inches.
 - 5. All conduit ends shall have an insulated bushing.

- Q. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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.

- R. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

- S. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet

locations. Install separate ground conductor across flexible connections.

- T. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- U. Set floor boxes level and flush with finished floor surface.
- V. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
- W. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- X. Do not route feeders across roof.
- Y. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- Z. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

3.3 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.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130

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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. Single and duplex receptacles and ground-fault circuit interrupters.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Floor service fittings.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.4 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. NEMA WD 1: General Requirements for Wiring Devices.
- D. NEMA WD 6: Wiring Device - Dimensional Requirements.
- E. UL 20: General-Use Snap Switches.
- F. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- G. UL 498: Electrical Attachment Plugs and Receptacles.
- H. UL 943: Ground Fault Circuit Interrupters.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.
- B. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to Specification Section "Electrical Testing."
- B. Source Limitations: Obtain each type of wiring device 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 NFPA 70.

1.7 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. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: General-Duty grade.

- B. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Configuration 5-20R duplex receptacle.

- 1. Manufacturers:

- a. Hubbell Incorporated; Wiring Device-Kellems HBL5362.
 - b. Cooper Wiring Devices 5362.
 - c. Pass & Seymour/LeGrand; Wiring Devices Division 5362A

- C. GFCI Receptacles: Straight blade, non-feed-through type, General-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943.

Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

1. Manufacturers:

- a. Hubbell Incorporated; Wiring Device-Kellems GF5352.
- b. Cooper Wiring Devices VGF20.
- c. Pass & Seymour/Legrand; Wiring Devices Division 2084

2.3 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.

2.4 WALL SWITCHES

A. Manufacturers:

1. Hubbell Incorporated; Wiring Device-Kellems 1220 Series.
2. Cooper Wiring Devices 1990 Series.
3. Pass & Seymour/Legrand; Wiring Devices Division PS20AC Series.

B. Device body: Plastic toggle handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: General-Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide pilot light where indicated.

- G. Provide key type where indicated. Furnish four keys to Owner.
- H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.5 DIMMER SWITCHES

A. General:

- 1. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
- 2. Dimmer switches shall provide full-range, variable control of light intensity utilizing a continuous Square Law dimming curve.
- 3. Provide protected memory during temporary power failures that restores lights to same level of intensity set prior to power interruption.
- 4. Provide dimmer switches UL listed for the type of load being served (incandescent, fluorescent, magnetic low voltage transformer, electronic low voltage transformer). Universal load-type dimmer switches shall not be acceptable.
- 5. Provide dimmers that provide no adverse effects on other components of the electrical system being served (low voltage transformers, ballasts, lamps, etc.).

B. Incandescent Lamp Dimmers:

- 1. Manufacturers:
 - a. Hubbell Incorporated; Wiring Device-Kellems S11I.
 - b. Lutron Skylark Series.
 - c. Leviton Renoir Series.
- 2. Modular, 120 V, 60 Hz with continuously adjustable control; single pole with soft tap or other quiet switch; and 5-inch (130-mm) wire connecting leads.
- 3. Dimmer switches serving magnetic low voltage transformers shall be designed to control and provide a symmetrical ac waveform to the input of the magnetic

low voltage transformer and not cause the transformer to operate above its rated operating current or temperature.

4. Dimmer switches serving solid-state low-voltage transformers shall not affect the sound rating of the transformer and not cause lamp flicker at any point in the dimming range.
5. Control: Continuously adjustable toggle switch with slider control; with single-pole or three-way switching to suit connections.
6. Power Rating: 1000W.

2.6 WALL PLATES

A. Manufacturers:

1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. 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- thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Gasketed Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

a. Manufacturers:

- i. Red Dot Model CKSGV (cast aluminum), Thomas & Betts.

2.7 FLOOR SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold.
3. Square D

B. Type: Modular, flush-type, with services indicated suitable for wiring method used.

- C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.
- D. Service Plate: Provide service plate type as indicated. Provide protective ring for flush service plates.
- E. Power Receptacle(s): NEMA WD 6, Configuration 5-20R General-duty grade duplex receptacle, white finish, unless otherwise indicated.
- F. Telecommunications Outlet: Quantity and type as indicated.

2.8 FINISHES

A. Color:

- 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.
- 2. Wiring Devices Connected to Technology Panelboards: Gray.
- 3. Wiring Devices Connected to Emergency Power System: Red.
- 4. Wall Switches: White, unless otherwise indicated.
- 5. Dimmer Switches: White, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.

- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging according to manufacturer's written instructions.
- E. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- F. Arrangement of Devices:
 - 1. Coordinate locations of outlet boxes provided under Division 16 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 - 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
 - 3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 - 4. Install horizontally mounted receptacles with grounding pole on the left.
 - 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
 - 6. Install switches with OFF position down.
- G. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- H. Use oversized plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- J. Remove wall plates and protect devices and assemblies during painting.
- K. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- L. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall

surfaces. Devices shall be solidly mounted against the box.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 16 Section "Electrical Identification" with black, red-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 16 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. 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.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
1. Inspect each wiring device for defects.
 2. Operate each wall switch with circuit energized and verify proper operation.
 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.

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4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

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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. Occupancy sensors.

1.3 REFERENCES

- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
- C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 1449: Transient Voltage Surge Suppressors.
- G. UL 1598: Luminaires.

1.4 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated including physical data and electrical performance.
- 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. Include the following:
 - 1. Description of operation and servicing procedures.
 - 2. List of major components.
 - 3. Recommended spare parts.

4. Programming instructions and system operation procedures.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Division 16 Section "Electrical General Requirements".
- B. Store and protect products under provisions of Division 16 Section "Electrical General Requirements".

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

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 OCCUPANCY SENSORS

A. General

1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor (provide with stainless steel coverplate that is compatible with sensor switch. Coverplate opening shall not obstruct switch operation).

1. Manufacturers:

- a. Wattstopper WS-200.
- b. Hubbell Building Automation SOM 101.
- c. Novitas 01 400.
- d. Sensorswitch WSD.
- e. Square D SLSPWS1277AI.
- f. Leviton equal.

2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.

- a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
 - b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
 - c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes. Ambient light sensing shall be adjustable from 20FC to 300FC, with override.
 - d. Ambient Light Sensor: Integral ambient light sensor to switch off lights when sufficient daylight is present.
 - e. Device Body: Ivory, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with "decora" style switch plate.
 - f. Coverage: 300 square foot minimum coverage for minor motion.
3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
- a. Manufacturers:
 - 1) Wattstopper WA-300.
 - 2) Hubbell Building Automation SOM-102.
 - 3) Novitas 01-DL400.
 - 4) Sensorswitch WSD-2P.
 - 5) Square D equal.
 - 6) Leviton equal.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
 - a. Wattstopper DT 300
 - b. Hubbell Building Automation "OMNI-DT3000" Series.
 - c. Novitas 01-300 BAS.
 - d. Square D SLSCDS2000.
 - e. Leviton equal.
2. Description: Ceiling mounted, 360° coverage, ultrasonic and infrared sensing occupancy sensor.

- a. Housing: White, thermoplastic, tamper resistant ceiling mount.
- b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
- c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 15 seconds to 30 minutes.
- d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
- e. Manual override function.
- f. Coverage: 1000 square foot minimum coverage per sensor, provide additional sensors per room to meet minimum coverage. Coverage shall sense small hand movement.

D. Occupancy Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
 - a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
 - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
 - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
 - e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling

- sensor, provided all required contacts are provided.
- f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 - EXECUTION

3.1 OCCUPANCY SENSOR INSTALLATION

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.
- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.
- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Conductors and Cables".

- 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 "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing 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.

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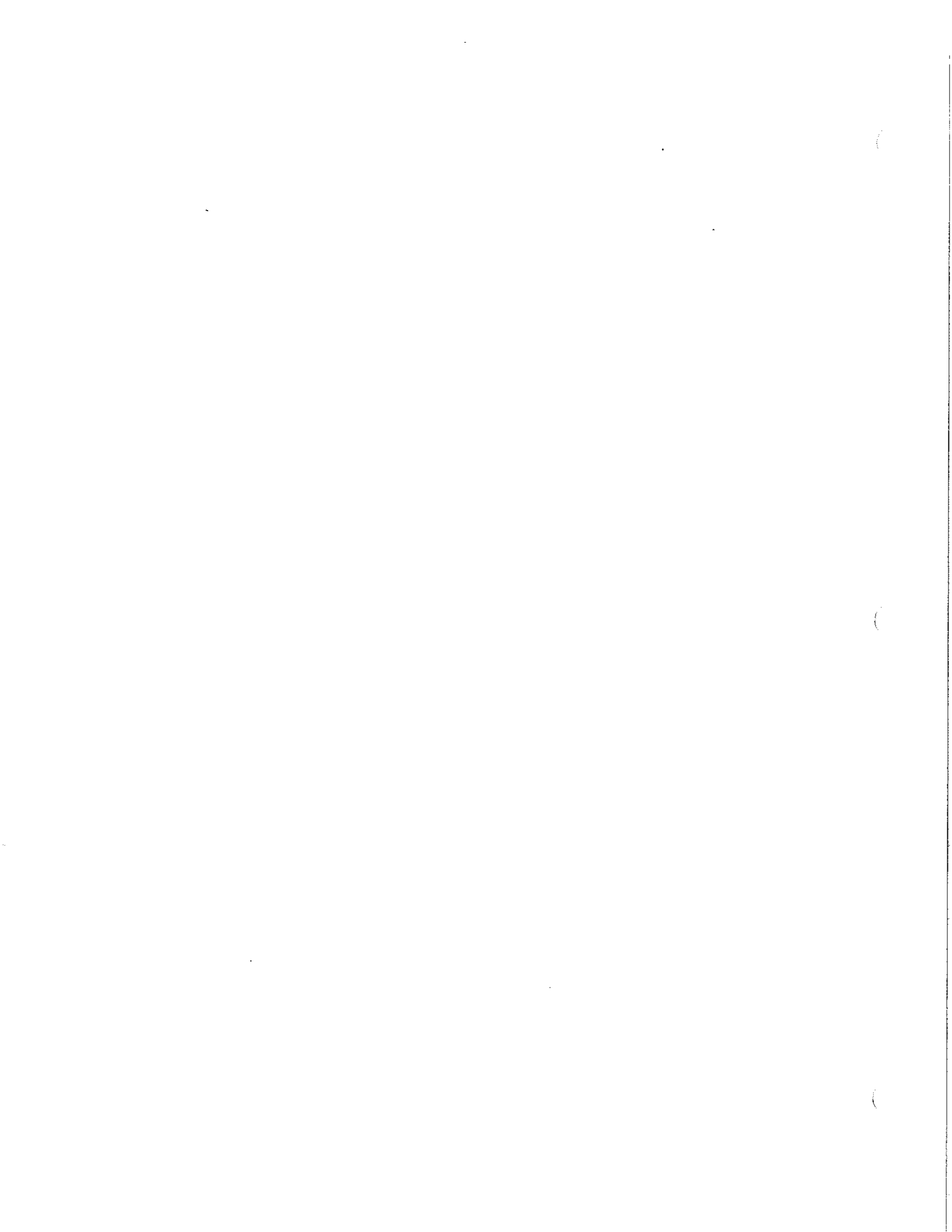
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3.5 ADJUSTING

- 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 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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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 individually mounted, enclosed switches and circuit breakers:

- 1. Fusible switches.
- 2. Nonfusible switches.
- 3. Molded-case circuit breakers.
- 4. Molded-case switches.
- 5. Enclosures.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. HD: Heavy duty.
- C. SPDT: Single pole, double throw.

1.4 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current rating.
 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Qualification Data: For manufacturer.
- D. 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.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers 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 enclosed switches and circuit breakers.

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.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

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. Spares: For the following:

- a. Potential Transformer Fuses: 2 of each size and type.
- b. Control-Power Fuses: 2 of each size and type
- c. Fuses for Fusible Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.

2. Spare Indicating Lights: Six of each type installed.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

- B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.

3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, 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.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.
- C. 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 material.
 2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Enclosure: Provide handle capable of being locked in the open position with padlock.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Indoor Dry Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 16 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- D. Install switches with off position down.
- E. Install NEMA KS 1 enclosed switches where indicated.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from enclosed switch to portable equipment. Leave a 6'-0" (1830 mm) whip.
- H. Install flexible liquid tight conduit from enclosed switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch (25 mm) from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.

- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 16 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

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. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Test mounting and anchorage devices according to requirements in Division 16 Section "Hangers and Supports for Electrical Systems."

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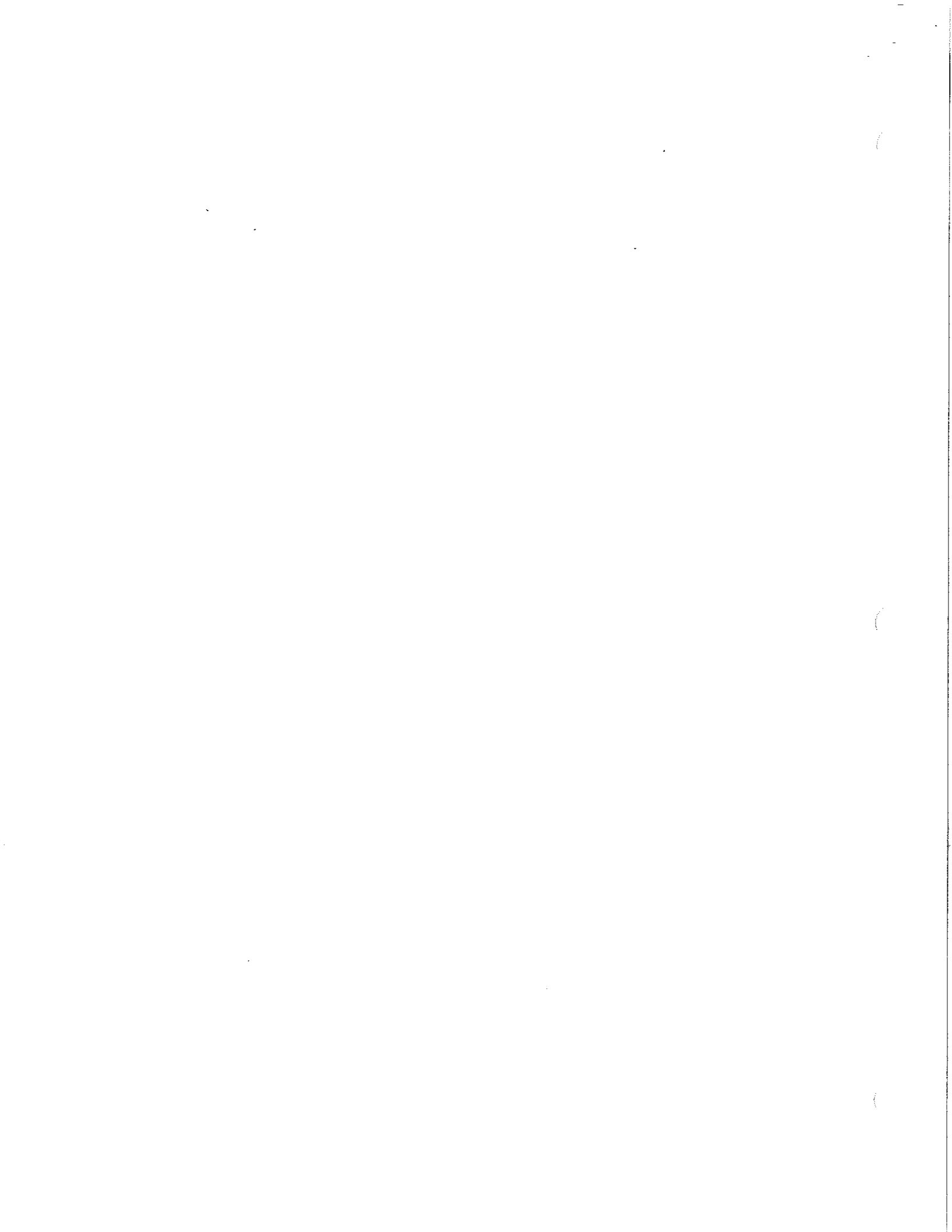
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2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410



SECTION 16420 - ENCLOSED CONTROLLERS

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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.

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. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- 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, 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 List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- E. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- F. NEMA KS 1 - Enclosed Switches.
- G. ANSI/NFPA 70 - National Electrical Code.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain enclosed controllers of a single 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 NFPA 70.

- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.
- B. Deliver products to site under provisions of Section 16010. Store and protect products under provisions of Section 16010.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.
- E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 16010.

1.8 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 size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. 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.

1.9 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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.
 - 3. Keys: Furnish 2 of each to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. 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 sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

C. 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. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.

3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.3 VARIABLE FREQUENCY CONTROLLERS

- A. Refer to Division 15 "Variable Frequency Controllers."

2.4 ENCLOSURES

- A. Description: Flush- or surface-mounting cabinets as indicated. 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.

2.5 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.
- C. Indicating Lights: Run (Red), off or ready (Green).
- D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
- E. Selector Switch: NEMA ISC 2, mounted in front cover to read "hand/off/auto," provide auxiliary contact for auto position monitoring.
- F. Control Relays: Auxiliary and adjustable time-delay relays.
- G. Elapsed Time Meters: Heavy duty with digital readout in hours.

- H. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

2.6 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. See Division 16 Section "Basic Electrical Materials and Methods" for general installation requirements.
- B. 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 "Basic Electrical Materials and Methods."

- C. Install freestanding equipment on concrete bases.
- D. Comply with mounting and anchoring requirements specified in Division 16 Section "Hangers and Support for Electrical Systems."
- E. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."
- F. Install motor control equipment and contactors in accordance with manufacturer's instructions.
- G. Select and install heater elements in motor starters to match installed motor characteristics.
- H. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

3.5 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 16 Section "Electrical Identification."

3.6 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.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.8 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. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
 3. Report results in writing.
- C. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing"
 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.

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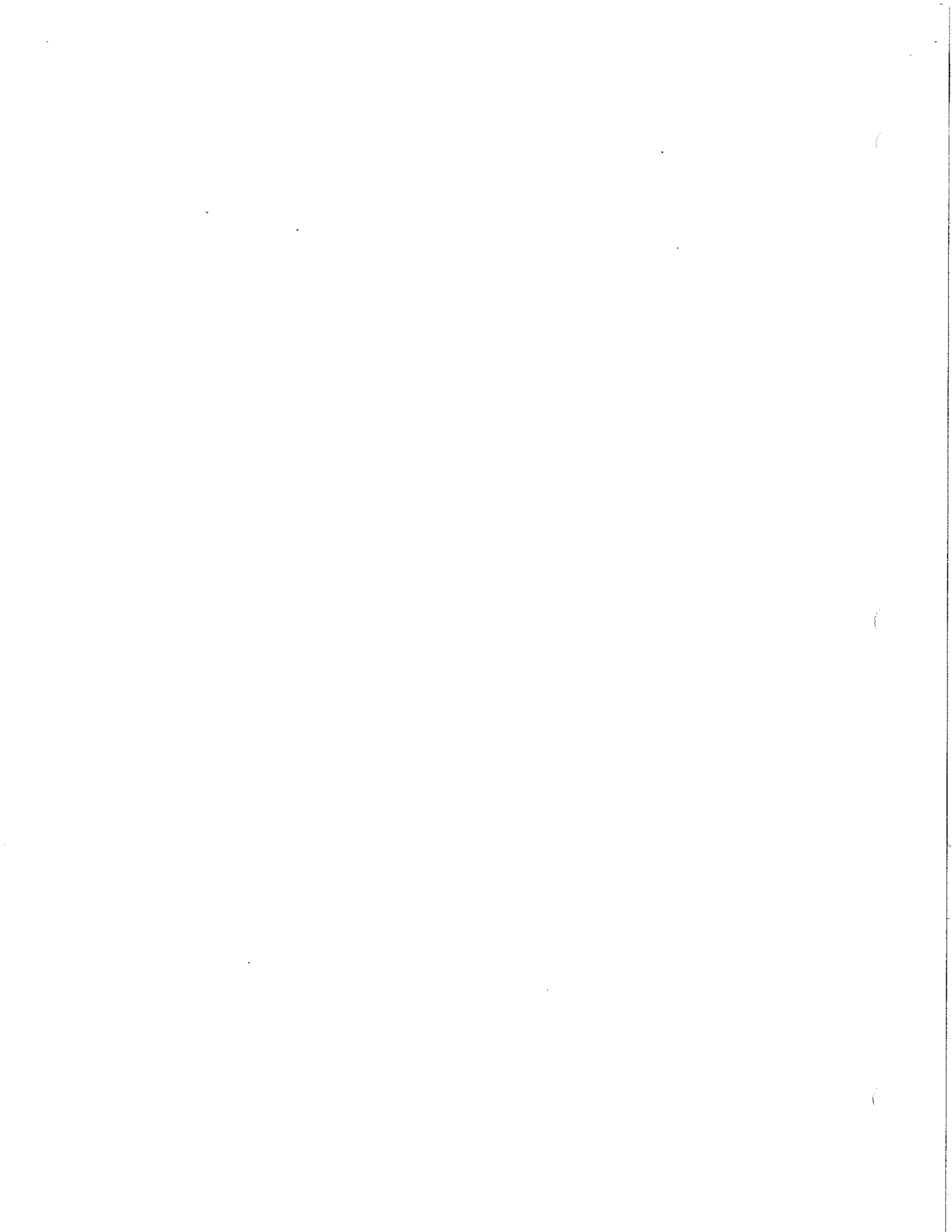
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2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

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 1."

END OF SECTION 16420



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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.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

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. 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.

- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

- E. 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. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1.
- 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 NEMA PB 1.
- E. 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. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet (2000 m).

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.

- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D/Group Schneider.

2.2 MANUFACTURED UNITS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Electrical Supports."
- B. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 - 1. Cabinet Front: Flush or surface cabinet as noted on the Drawings, with front with concealed trim clamps,

piano type hinged dead front cover, hinged door, and flush lock all keyed alike.

2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
3. 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.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

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. Main bus bars, neutral and ground, shall be aluminum and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

- C. Main Overcurrent Protective Devices: Circuit breaker.

D. 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. Main bus bars, neutral and ground, shall be aluminum and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.6 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 with restricted access cover.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-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. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system

specified in Division 16 Section "Electrical Power Monitoring and Control."

5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Do not use tandem circuit breakers.
7. Provide circuit breakers U.L. listed as type GFEPIC for all self regulating heating (snow melting and heat trace) cables branch circuits.
8. Provide lock on devices for circuit breakers when called out on panel schedules with "LOD" designation.
9. Provide ground fault interrupt 5ma circuit breaker when called out on panel schedules with "GFI" designation.
10. Provide shunt trip breakers when called out on panel schedules with "STB" designation.
11. Provide smart controllable circuit breakers when called out on panel schedules with "SMT" designation.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

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 "Hangers and Supports 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 or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with (owner) (facility engineer).

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. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing"
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. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
 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: Refer to Specification Section 16999 "Electrical Testing."

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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 16491 - FUSES

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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 Section, 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:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 2. NFPA 70 - National Electrical Code.
 3. UL 198C - High-Interrupting-Capacity Fuses, Current-Limiting Types.
 4. UL 198E - Class R Fuses.
 5. UL 512 - Fuseholders.

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: Quantity equal to 10% percent of each fuse type and size, but no fewer than three of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Cooper Bussman, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

- 1. Motor Branch Circuits: Class RK1, time delay.

2.3 FLUORESCENT BALLAST FUSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc. - GLR fuses with HLR holder.
 - 2. Tracor, Inc.; Littelfuse, Inc. Subsidiary - LGR fuses with LHR-000 holder.
 - 3. Ferraz Shawmut, Inc. - SLR fuses.
- B. Provide each fluorescent ballast with individual protection on the line side.
- C. Provide fuse and holder mounted within or as part of the fixture.
- D. Provide fuse size and type recommended by the fixture manufacturer.

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 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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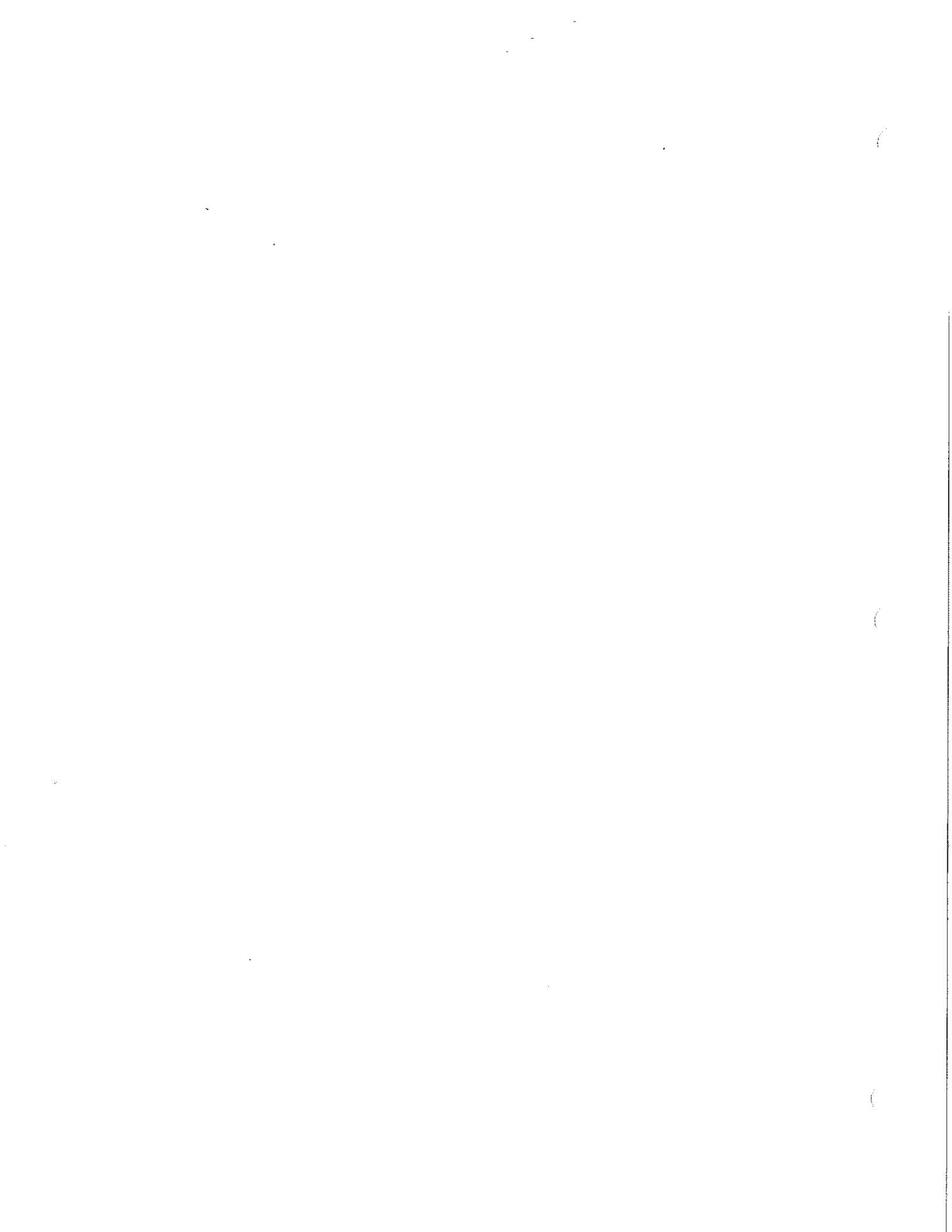
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3.3 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491



SECTION 16511 INTERIOR LIGHTING

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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. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Accessories, including lighting fixture retrofitting.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
2. Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
3. Division 16 Section "Dimming Controls" for architectural dimming systems.

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. Submit under provisions of Section 26 0010.

- B. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Submit as one package, bound together. 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. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
 5. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 15 Section "Diffusers, Registers and Grilles."
 6. Lamps.
 7. Photometric performance data.
- C. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- D. Wiring Diagrams: Power, signal, and control wiring.
- E. Coordination Drawings: Reflected ceiling plan(s) 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 lighting-fixture suspension systems will be attached.
 3. Other items in finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 4. Perimeter moldings.

- F. Samples for Verification: For interior lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.
 - 1. Lamps: Specified units installed.
 - 2. Ballast: 120-V models of specified ballast types.
 - 3. Accessories: Cords and plugs.
- G. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
- H. Source quality-control test reports.
- I. Field quality-control test reports.
- J. Operation and Maintenance Data: For lighting equipment and fixtures 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. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.
- K. Warranties: Special warranties specified in this Section.

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:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NECA/IESNA 500-1998 - Recommended Practice for Installing Indoor Commercial Lighting Systems.
 - 3. NECA/IESNA 502-1999 - Recommended Practice for Installing Industrial Lighting Systems.
 - 4. Resource Conservation and Recovery Act (RCRA), May 1994.
 - 5. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
 - 6. Code of Federal Regulations (47 CFR 37342).

7. Michigan Department of State Police, Fire Marshall Division Policy Number 11-06 "Plastic Materials as Interior Finishes" pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
 8. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
- C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- E. Mockups: Provide lighting fixtures for room or module mockups. Install fixtures for mockups with power and control connections.
1. Obtain Architect's approval of fixtures for mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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. The Electrical Contractor shall provide labor to remove failed

ballasts and install replacement ballasts for the warranty period listed below.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

B. Manufacturer's Special Warranty for T8 and T5 Fluorescent Lamps: Manufacturer's standard form, made out to The Electrical Contractor and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship. The Electrical Contractor shall provide labor to remove and reinstall new lamps within specified warranty period indicated below.

1. Warranty Period: Three 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: Furnish 20 of each type.
2. Electronic Ballasts: Furnish 12 of each type.
3. Gymnasium Light Fixture Guards: Furnish 6 of each type.

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. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 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. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1572. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. 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.
- H. 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.
- I. 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.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
 - b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461D. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.
- K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."
1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 2. Heat Removal Units: Air path leads through lamp cavity.
 3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
 4. Dampers: Operable from outside fixture for control of return-air volume.
 5. Static Fixtures: Air supply slots are blanked off, and fixture appearance matches active units.
- L. General: Install ballasts, and specified accessories at factory. Install lamps on project site after fixture installation.

2.3 LIGHTING FIXTURES

- A. As indicated on the drawings.

2.4 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 except for emergency lamps powered by in-fixture battery-packs.
 2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.

B. Program rapid start electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:

1. Products:
 - a. Advance.
 - b. Sylvania/Motorola.
2. Comply with NEMA C82.11.
3. Ballast Type: Programmed rapid start, unless otherwise indicated.
4. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
5. Sound Rating: A.
6. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11. Input current third harmonic content shall not exceed 10%.
7. Transient Voltage Protection: IEEE C62.41, Category A.
8. Operating Frequency: 25 kHz or higher, and operate without visible flicker.
9. Lamp Current Crest Factor: Less than 1.7.
10. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
11. Power factor shall be 90% minimum.
12. Ballast factor shall be .875 to 1.00.

C. Electromagnetic ballasts for linear lamps shall have the following features, unless otherwise indicated:

1. Products:
 - a. Advance.
 - b. Universal Lighting Technologies.
 - c. Valmont Electric
2. Comply with NEMA C82.1.
3. Type: Energy-saving, high power factor, Class P, automatic-reset thermal protection.
4. Ballast Manufacturer Certification: Indicated by label.
5. Provide lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
6. Provide ballast suitable for lamps specified.
7. Ballast shall not exceed sound level above Class A.

D. Ballasts for compact lamps shall have the following features, unless otherwise indicated:

1. Products:
 - a. Prescolite.
 - b. Advance.
 - c. Sylvania/Motorola.
2. Type: Electronic.
3. Power Factor: 90 percent, minimum.
4. Flicker: Less than 5 percent.
5. Lamp Current Crest Factor: Less than 1.7.
6. Electronic Ballast Operating Frequency: 25 kHz or higher.
7. Lamp end-of-life detection and shutdown circuit.
8. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
9. THD shall be 20% or less. Input current third harmonic content shall not exceed 20%.
10. Ballast shall be UL listed, Class P with a sound rating at or below Class A.
11. 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 dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:

1. Products:
 - a. Advance: Mark 10.
 - b. Lutron.
 - c. Prescolite (compact fluorescent lamps only).
2. Dimming Range: 100 to 5 percent of rated lamp lumens.
3. Ballast Input Watts: Can be reduced to 20 percent of normal.
4. Compatibility: Certified by manufacturer for use with specific dimming system indicated.
5. Provide ballast suitable for specified lamp type.

F. Ballasts for Low-Temperature Environments:

1. Temperatures 0 deg F and Higher: Electronic or electromagnetic type rated for 0 deg F minus 17 deg C starting temperature.
 2. Temperatures Minus 20 deg F (Minus 29 deg C) and Higher: Electromagnetic type designed for use with high-output lamps.
- G. 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.

2.5 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 or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Provide ballast suitable for lamp specified.
 6. Manufacturers:
 - a. Advance.
 - b. Universal Lighting Technologies.
 - c. Valmont Electric.
- 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. Sound rating - 'B' or better.
- D. High-Pressure-Sodium Ballasts: Solid-state igniter/starter with an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant Restrike Device: Solid-state potted module, mounted inside high-pressure-sodium fixture and compatible with high-pressure-sodium lamps, ballasts, and sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.

E. Metal Halide Pulse Start Ballast

1. Manufacturers:
 - a. Advance.
 - b. Venture.
2. Description: ANSI C82.4, metal halide lamp pulse start ballast.
3. Provide ballast suitable for pulse start lamp specified.
4. Sound Rating: "B" or better.
5. Lighting Performance Requirements:
 - a. Ballasts must be designed to provide reliable lamp starting down to -40°C for high pressure sodium and -20°C for metal halide.

2.6 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: Incandescent, 2 for each fixture, 50,000 hours of rated lamp life.
 2. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 3. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
 4. Additional Lamps for DC Operation: Two minimum, bayonet-base type, for connection to external dc source.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

D. Provide edge lit signs with a mirror plaque background.

2.7 EMERGENCY LIGHTING UNITS

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: Where indicated, 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.

2.8 FLUORESCENT EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Emergency Connection: Operate two fluorescent lamps continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

2. Night Light Connection: Operate two fluorescent lamps continuously.
3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space. Install remote test switch and plate in adjacent ceiling tile.
4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Lamp Ratings:

<u>Lamp Type</u>	<u>Minimum Lumen Output</u> <u>(one or two lamps)</u>
F25T8	1250/1100
F32T8	1350*
F28T5	1245*
F54T5HO	1200
PLT70W	1200
PLT57W	1150
PL-T 42W	1000
PL-T 32W	700/1000
PL-T 26W	575/875
PL-T 18W	375/625
F13TBX/PL-C 13W	350/425
PL-C 26W	450/700
PL-C 18W	375/500
F50 BX	900*
F40 BX	900*
F39/36 BX	1100*
F27/24 BX	1100*
F18 BX	500*

* Indicates ratings for minimum output
for one and two lamps.

7. Self test electronic circuitry to monitor battery charging current and voltage. Provide audible alarm and L.E.D. to indicate results.
8. Universal transformer to operate at 120 volt or 277 volt.
9. Products, slim line style:
 - a. Bodine.
 - b. Lithonia.
 - c. Dual Lite.

d. Iota.

10. Products, compact fluorescent:

- a. Bodine.
- b. Lithonia.
- c. Dual Lite.
- d. Iota.

11. Products, linear fluorescent:

- a. Bodine.
- b. Lithonia.
- c. Dual Lite.
- d. Iota.

2.9 EMERGENCY LOAD TRANSFER DEVICE

A. Manufacturers:

- 1. Nine-24, Inc.: BLTC Series.
- 2. Bodine GTD Series.
- 3. Dual Lite.
- 4. LVS.
- 5. Side-Lite.

B. Description: Localized load transfer switch to sense normal presence of normal power for switched circuits and switch luminaire over to emergency source upon loss of normal source. Device shall be installed integral to luminaire or mounted remotely as application required.

C. U.L. 924 Listed.

D. Integral test switch and indicating lamps to indicate status.

2.10 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, rated 32 W maximum, 2900 initial lumens (minimum), CRI of 85 (minimum), color

temperature of 4100 K, and average rated life of 24,000 hours at 3 hours operation per start, unless otherwise indicated.

- C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches 610 mm, 1300 initial lumens (minimum), CRI of 85 (minimum), color temperature of 4100 K, and average rated life of 24,000 hours at 3 hours operation per start, unless otherwise indicated.
- D. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
1. T4, Twin Tube: Rated 5 W, 250 initial lumens (minimum).
 2. T4, Twin Tube: Rated 7 W, 400 initial lumens (minimum).
 3. T4, Twin Tube: Rated 9 W, 600 initial lumens (minimum).
 4. T4, Twin Tube: Rated 13 W, 825 initial lumens (minimum).
 5. T4, Twin Tube: Rated 18 W, 1250 initial lumens (minimum).
 6. T4, Twin Tube: Rated 24 W, 1800 initial lumens (minimum).
 7. T4, Twin Tube: Rated 36 W, 2900 initial lumens (minimum).
 8. T4, Twin Tube: Rated 50 W, 4300 initial lumens (minimum).
 9. T4, Double-Twin Tube: Rated 13 W, 900 initial lumens (minimum).
 10. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
 11. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).
 12. T4, Triple Tube: Rated 18 W, 1200 initial lumens (minimum).
 13. T4, Triple Tube: Rated 26 W, 1800 initial lumens (minimum).
 14. T4, Triple Tube: Rated 32 W, 2400 initial lumens (minimum).
 15. T4, Triple Tube: Rated 42 W, 3200 initial lumens (minimum).

E.

F. Fluorescent Lamp Manufacturers:

1. Osram Sylvania.
2. General Electric.
3. Philips.

- G. T5HO rapid start low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches 1148 mm, 4600 initial lumens (minimum), CRI greater than 80, color temperature 4100 K, and average rated life of 30,000 hours, unless otherwise indicated.

2.11 HIGH-INTENSITY-DISCHARGE LAMPS

A. High Intensity Discharge (HID) Lamp Manufacturers:

1. Osram Sylvania.
2. General Electric.
3. Philips.
4. Venture.

- B. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature 1900, and average rated life of 24,000 hours.

- C. Low-Pressure-Sodium Lamps: NEMA C78.41.

- D. Metal-Halide Pulse Start Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum), and color temperature 4000.

1. Acceptable manufacturers.

- a. Venture.
- b. Osram Sylvania.
- c. Philips.

2. Description

- a. ANSI Type M.
- b. If used in an open luminaire, the lamp must be rated (0) for use in an open fixture and incorporate a protective arc tube shroud design.

2.12 INCANDESCENT LAMPS

A. Manufacturers:

1. Osram Sylvania.
2. General Electric.
3. Philips.

- B. Lamps shall be rated 120 volt and shall have a life of 2000 hours minimum.

2.13 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Electrical Supports" 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.

2.14 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.

2.15 FLUORESCENT FIXTURE RETROFIT MATERIALS

A. Comply with UL 1598 listing requirements.

1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces. No electrical parts are to be changed.
2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets as scheduled.

2.16 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. Install in accordance with manufacturers instructions.
- B. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- C. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- D. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 1. Install a minimum of four ceiling support system rods or wires for each fixture. 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 two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- F. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Fixture Support: As follows:
1. Install suspended luminaires and exit signs using pendants supported from swivel hangers except where noted to use chain hangers. Provide pendant length required to suspend luminaire at indicated height.
 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 3. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 4. 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.
 5. Continuous Rows: Suspend from cable.
- J. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.
- K. Adjust aimable fixtures to provide required light intensities.
- L. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

- M. Where fluorescent fixtures are shown with dual switches, connect all inner lamps to one switch and all outer lamps to the other switch. Dim the inner lamps where a dimmer switch is shown.
- N. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.
- O. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- P. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Non-functioning lamps shall be replaced.
- Q. Mount fluorescent emergency lighting battery packs in accordance with the manufacturer's instructions. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.
- R. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.

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.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Section 16130 using 1/2" flexible conduit.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Examine each luminaire to determine suitability for lamps specified.
- C. Verify normal operation of each fixture after installation.
- D. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- F. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.
- G. Check for variance in lamp color temperature throughout project.
- H. Spot check for lamp output level from start up through 10 minute duration and make rotation.
- I. All fluorescent and H.I.D. lamps shall be allowed to run a minimum of 100 hours, continuously, prior to punchlist or any dimming.
- J. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.4 ADJUSTING

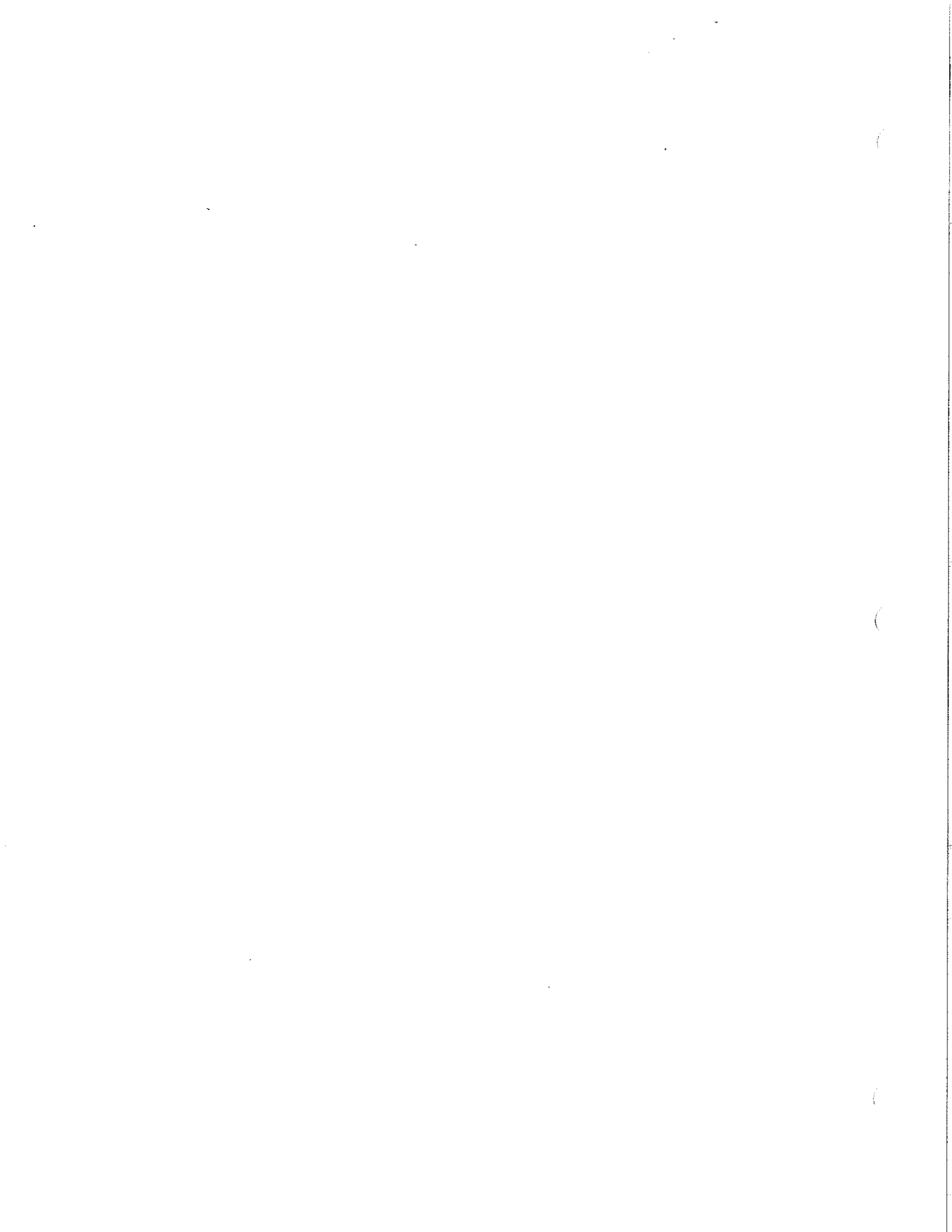
- A. Aim and adjust luminaires as directed by the Architect/Engineer.
- B. Adjust exit sign directional arrows as indicated on Drawings.

- C. Relamp luminaires that have failed lamps at Substantial Completion.
- D. Adjust all "low end trim" settings of dimming switches prior to punchlist.
- E. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.5 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

END OF SECTION 16511



SECTION 16721 - FIRE ALARM

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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 work of this section.

B. Related Sections include the following:

1. Division 16 Section "Electrical General Requirements."

1.2 SECTION INCLUDES

- A. Fire alarm and smoke detection systems. This section intends to describe a Protected Premises Fire Alarm System. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular with multiplex communication techniques, in full compliance with all applicable codes and guidelines. The features and system capacities contained in this specification shall be furnished as part of this project.
- B. The system as described shall be installed, tested, and delivered to the Owner in first class condition. The system shall include all the required hardware and software to accomplish the requirements of this specification and the contract documents, whether or not specifically itemized herein.
- C. All equipment furnished shall be new and include the latest state of the art products from a single manufacturer, engaged in the manufacturing and sale of fire detection devices for over ten years. The equipment manufacturer shall have an installed base of existing systems as a reference.

1.3 REFERENCES

- A. NFPA 72 - National Fire Alarm Code.
- B. NFPA 101 - Life Safety Code.
- C. U.L. 1971 - Standard for Safety Signaling Devices for the Hearing Impaired.

1.4 REGULATORY REQUIREMENTS

- A. System: UL (FPED) and FM listed.
- B. Conform to requirements of NFPA 101.
- C. A.D.A. Federal guidelines.
- D. Conform to State of Michigan Fire Code.

- E. Conform to International Building Code.

1.5 SUMMARY

- A. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 1. Fire Alarm and Detection Operations.
 2. Remote Monitoring of Sprinkler Systems.
 3. Remote Manual and Automatic Control of all Door Hold-open Devices, and other auxiliary functions indicated on the drawings.

1.6 SYSTEM DESCRIPTION

- A. General: Complete, zoned, noncoded, addressable, microprocessor-based fire detection and alarm system with manual and automatic alarm initiation, addressable analog initiating devices, and automatic alert.
- B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel (FACP).
- C. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate future changes.
- D. Resident software shall allow for configuration of notification appliance and control circuits so that additional hardware shall not be necessary to accommodate changes.
- E. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- F. Signal Transmission: Notification appliance circuits shall be NFPA Style Y, Class B. Signaling line circuits shall be NFPA Style 4, Class B.

- G. Data Communication Transmission Between Control Units:
Style 7, Class A.

1.7 SYSTEM FUNCTIONS

- A. Signal Initiation: The manual or automatic operation of an alarm-Initiating or supervisory-operating device shall cause the FACP to transmit an appropriate signal including:

1. General alarm.
2. System trouble.
3. Valve tamper supervisory.
4. Door release.
5. Fan shutdown.
6. Release electrically held door locks.
7. A general alarm shall be initiated by:
8. Water-flow alarm switch operation.
9. Smoke detection. Alarm verification is required for all smoke detector zones.
10. Manual station operation.
11. Heat detector operation.

- B. General Alarm: A system general alarm shall:

1. Indicate the general alarm condition at the FACP.
2. Identify the device that is the source of the alarm at the FACP.
3. Display the alarm on an 80 character LCD display. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control unit. The display shall show the new alarm information.
4. Sound a pulsing alarm tone within the FACP until the event has been acknowledged.
5. Operate audible and visible alarm notification signals throughout the building.
6. Sound a continuous fire alarm signal until silenced by the alarm silence switch at the FACP.
7. Flash all visible alarm notification appliances continuously until the System Reset Switch is operated. Any subsequent zone alarm shall reactivate the alarm notification appliances.

8. Close fire and smoke doors normally held open by magnetic door holders.
 9. Stop supply and return fans serving zone where alarm is initiated.
 10. Close smoke dampers on system serving zone where alarm is initiated.
 11. Transmit the alarm to the proprietary supervising station.
- C. A supervisory alarm shall be initiated by:
1. Sprinkler valve tamper switch operation.
- D. Loss of primary power at the FACP shall sound a trouble signal at the FACP and shall indicate at the FACP when the system is operating on an alternate power supply.
- E. Circuit Supervision: Circuit faults shall be indicated by means of both a zone and a trouble signal at the FACP.
- F. Annunciation: Manual and automatic operation of alarm and supervisory initiating devices shall be annunciated on the FACP, indicating the location and type of device.
- G. FACP Alphanumeric Display: Shall display plain-language description of alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
- H. Independent System Monitoring: Supervise each independent smoke detector, fire suppression system and duct detector, for both normal operation and trouble.
- I. Alarm Silencing: If the "Alarm Silence" button is pressed, all audio alarm signals shall cease operation.
- J. System Reset: The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
- K. Activation of an auxiliary bypass switch shall override the selected automatic functions.
- L. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP.

- M. Recording of Events: Record all alarm, supervisory, and trouble events in non-volatile memory.
- N. Smoke Sensor Sensitivity Adjustment:
1. Authorized operation of controls at the FACP shall cause the selection of specific addressable smoke sensors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings.
 2. Remote Controllability: Individually monitor sensors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP. The alarm decision for each sensor shall be determined by the control unit. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
- O. The actuation of the "enable one person test" program at the FACP shall activate the "One Person Testing" mode of the system which shall cause the following to occur:
1. The city circuit connection shall be bypassed.
 2. Control relay functions shall be bypassed.
 3. The FACP shall show a trouble condition.
 4. The alarm activation of any initiation device shall cause the audible notification appliances to code a number of pulses to match the zone number.
 5. The FACP shall automatically reset after signaling is complete.
 6. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
 7. The system shall have the capacity of 8 programmable, passcode protected, one person testing groups, such that only a portion of the system need be disabled during testing.
- P. Power Requirements
1. The FACP shall receive 120 VAC power via a dedicated 20A branch circuit breaker provided with a red lock-on device.
 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for

a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
 4. The incoming power to the system shall be supervised so that any power failure must be audibly and visibly indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
 5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the FACP and the command center.
- Q. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

1.8 SUBMITTALS

- A. Bidders will be required to submit shop drawings and product data during the construction phase of each project. Provide the following submittals for review:
1. Complete description data indicating UL listing for all network components. Include dimensioned plans and elevations showing minimum clearances and installed features and devices.
 2. Complete sequence of operation of all functions of the network that is project specific.
 3. A list of every address of every device connected to a panel that is provided for purposes of alarm initiating, status monitoring, supervised notification appliance circuits, and auxiliary control.
 4. A listing of the manufacturer's representatives responsible for installation coordination and service.
 5. Location of all controls, alarm actuating devices and notification appliance devices as shown on drawings.
 6. Wiring diagrams from manufacturer differentiating between factory-and field- installed wiring. Include diagrams for equipment and for system with all

- terminals and interconnections identified. Indicate components for both field and factory wiring. Provide complete diagrams for all components and interfaces including equipment supplied by others.
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
 8. The manufacturer shall provide calculations for battery size as applicable. Battery size shall be a minimum 125% of the calculated requirement.
 9. Provide calculations for control modules indicating circuit loading with 20% spare capacity.
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of annotated Contract Drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, submit them for review. Make resubmissions if required to make clarifications or revisions to obtain approval.
- 1.9 PROJECT RECORD DOCUMENTS
- A. Submit as built drawings locating devices and conductor runs.
 - B. Record of field tests of system.
 - C. Submit manufacturer's certificate that system meets or exceeds specified requirements.
- 1.10 OPERATION, MAINTENANCE DATA, AND CALCULATIONS
- A. Provide to the Owner's representative operating instructions, maintenance, and repair procedures.
 - B. After installation, include manufacturer representative's letter stating that system is operational.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage and handling of products will take place under the contract terms of each project in the construction phase of each project.

1.12 EXTRA MATERIALS

- A. Provide spare parts to the Owner's representative as noted below:
 - 1. Two keys of each type.
 - 2. Two smoke detectors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. National Time & Signal (Existing 902 series panels).

Provide all parts and components required to expand the existing FACP (National Time & Signal 902 series) to serve the new devices as indicated on the drawings and required by the authorities having jurisdiction. Coordinate all requirements with National Time & Signal.

2.2 FIRE ALARM CONTROL PANEL (FACP).

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
- B. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of units as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch high.

- C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in modules. Construction requiring removal of field wiring for module replacement is not acceptable.
- D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems plus 20% for future expansion. Local visible, and audible signals notify of alarm, supervisory, and trouble conditions
- E. Zones: Provide for all alarm and supervisory zones indicated.
- F. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.
- G. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 80 characters displays alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.
- H. System power supplies including necessary transformers, regulators, filters and surge protection required for system operation.
- I. System processor, with internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm signals and issue output. Total system response time shall not exceed 2.5 seconds on a system configured to the 3000 point capacity. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Systems with single watchdog circuits for all processors will not be accepted unless furnished with a standby CPU.
- J. Digital communications capabilities required for the control panel to communicate with remote panels annunciators and displays.

- K. A limited energy output circuit for operation of direct current (DC) audible or visual devices, leased line or city tie, shall be provided by a controllable signal module.
- L. Where control of operations requiring switching functions is indicated, there shall be provided a software controlled relay module.
 - 1. Motherboards shall be furnished as the system bus furnishing systems communications to the various plug in modules necessary for system operations.
- M. Remote Station Signal Transmitter: Electrically supervised, capable of transmitting contact I.D. and point annunciation signals over telephone lines to remote central station receiver. The electrical contractor shall provide a 3/4" conduit with (2) dedicated telephone lines from the FACP to the telephone equipment located in the Head End Room (field verify exact location).

2.3 REMOTE FIRE ALARM ANNUNCIATOR PANEL

- A. Provide remote annunciation and control using an 80 character, back-lit, alphanumeric, LCD readout. Alarm indication shall be identical to that at the main FACP including tone alert. Provide a minimum of four programmable control switches, alarm silence and system reset.
- B. Provide brushed aluminum trim plate.

2.4 EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

- C. Magnetic door holders are not served by emergency battery power. Magnetic door holders are released after 15 seconds when normal power fails.

2.5 SMOKE DETECTORS, INTELLIGENT ADDRESSABLE

- A. Furnish and install where indicated on the drawings intelligent analog smoke detectors with features and characteristics as follows:
 - 1. Photoelectric detectors shall be listed for use as open area protective coverage, in duct installation and shall be insensitive to air velocity changes.
 - a. The control panel shall provide a sensitivity readout for all detectors without removal from the pluggable base. Detectors not listed for sensitivity testing and logging from the control panel are not acceptable.
 - b. Detectors shall be operational with relay bases (as applicable), audible bases, and remote indicating LED's, programmable by the control panel and controlled by the detector electronics.
- B. Provide smoke detectors above fire alarm control panel, remote annunciator panels, and remote notification appliance power supply panels.
- C. Provide smoke detectors with auxiliary set of contacts where required.

2.6 THERMAL DETECTOR, INTELLIGENT ADDRESSABLE

- A. The intelligent thermal detectors shall be of the rate compensated fixed temperature type and shall be listed by Underwriters Laboratories, Inc. The intelligent thermal detectors shall be individually annunciated on the control panel. The intelligent thermal detectors shall contain an integral alarm lamp.

2.7 DUCT SMOKE DETECTORS

- A. The air duct detector shall be listed by Underwriters Laboratories, Inc. The air duct detector shall operate on

a cross-sectional air sampling principle to overcome stratification and the skin effect. The air duct detector shall consist of a standard (intelligent/analog) photoelectric detector mounted in an air duct sampling assembly and sampling tube that protrudes across the duct of the ventilating system. The air duct detector shall retain the features of the intelligent/analog photoelectric detector, and be installed in the ventilating duct as indicated in the manufacturer's instructions. Provide with addressable control module. Relay based duct detectors not acceptable.

- B. The duct mounted detector shall have an auxiliary set of contacts in order for the temperature controls contractor to tie in the starter of the fans. Contacts shall be rated 1A, 120V.

2.8 DUCT SMOKE DETECTOR REMOTE ALARM INDICATORS

- A. Provide remote alarm indicator station for duct smoke detectors (for HVAC units and smoke dampers) located above ceilings or in other locations above 10 feet and/or not readily accessible.
- B. Provide LED alarm indicator designed for mounting in a single gang coverplate.

2.9 MANUAL STATIONS, INTELLIGENT

- A. Provide single action intelligent manual stations where shown on the drawings, to be flush or surface mounted as required.
 - 1. The manual stations shall be addressable and identifiable by the fire alarm control panel.
 - a. Address assignments shall be set mechanically or electronically and reside within the station in non volatile memory.
 - b. Station Reset: Key operated switch.
 - 2. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover

actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.10 ADDRESSABLE INTERFACE MODULE

A. Provide for integration of compatible two wire and shorting style contact devices into the analog signaling circuit. Intelligent analog signaling circuit interface module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of reporting alarm or trouble conditions from the devices monitored.
2. Compatibility with ionization, photoelectric, and linear beam style smoke detectors, heat detectors, and all listed contact type devices.
3. The module shall be addressable and identifiable by the control panel.
 - a. Address assignments shall be set mechanically or electronically and reside within the module in non volatile memory.
4. Water Flow Switches: The water flow switches shall be provided by the mechanical contractor and wired by the electrical contractor. The switches shall be connected to the fire alarm system through the use of addressable interface modules.
5. Tamper Switches: The tamper switches shall be provided by the mechanical contractor and wired by the electrical contractor. The switches shall be connected to the fire alarm system through the use of addressable interface modules.
6. Provide addressable interface modules to uniquely identify each flow and tamper switch.

2.11 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of initiating a control

function to an auxiliary device based on a specified event.

2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.12 AUDIO VISUAL DEVICES

- A. Alarm Strobes (Visual): Visual alarm signals shall be furnished with minimum light intensity of 15cd average (horizontal and vertical distribution listed in accordance with UL 1971) and meet A.D.A. 75cd minimum intensity at horizontal and vertical axis and shall comply with the following:
 1. Xenon strobe with minimum repetition rate of 1 HZ, not exceeding 2 HZ and a maximum duty cycle of 40% with a pulse duration of .2 seconds.
 2. Unfiltered or clear white light not exceeding 1000 candela.
 3. Visual signals shall be mounted at 96 inches above finish floor level, or six inches below ceiling level whichever is lower in accordance with NFPA 72, 1996. Provide wall mounted or ceiling mounted devices, as indicated on plans.
 4. Visual signals shall flash in synchronization in all corridors and in rooms where more than one strobe is installed.
- B. Alarm Horns: The alarm horns shall be of the polarized 24 VDC type. The mechanisms shall contain an aerospace grade aluminum diaphragm, tempered and polished armature, and tungsten contact point, all housed in a red die-cast frame and grill assembly. Horns shall have an integral strobe light that will flash during an alarm. Horns shall have a minimum sound level of 93 dB at 10 feet.
- C. Combination notification appliances (horn/strobe) consist of factory-combined, audible and visual notification units in a single mounting assembly. Provide wall mounted or ceiling mounted devices, as indicated on plans.
- D. Audible devices shall be furnished to provide minimum of 15 db above ambient sound levels. Maximum sound levels shall not exceed 120 db, provisions shall be made to adjust the audible levels accordingly.

2.13 AUXILIARY DEVICES

- A. Door Release: Magnetic door holder with integral diodes to reduce buzzing, 24 VDC coil voltage.

2.14 WIRE AND CABLE (ALL WIRE AND CABLE SHALL BE RED)

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- 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

PART 3 - EXECUTION

3.1 WARRANTY

- A. All equipment and systems shall be warranted by the contractor for a period of two years following acceptance. The warranty shall include parts, labor, prompt field service, pick-up and delivery.
- B. Provide two years testing and maintenance, which shall consist of:
 - 1. Regularly and systematically examining all detectors, manual stations, panels, relays, pressure switches and accessories pertaining to the system.
 - 2. Regularly and systematically examine, adjust and clear all the electrical and mechanical components of water flow switches.
 - 3. Tests and written reports which certify that all initiating devices have been tested and which indicate

the result of the inspection test as required by the authority having jurisdiction.

3.2 TESTS AND REPORTS

- A. The contractor shall perform all electrical and mechanical tests required by the equipment manufacturer's certification form. In addition, they shall measure and adjust each of the ionization detectors to the maximum stable sensitivity setting. This must be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. All test and report costs shall be in the unit price established for each device. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:
1. A complete list of equipment installed and wired.
 2. Indication that all equipment is properly installed and functions and conforms with these specifications.
 3. Test of individual zones as applicable.
 4. Serial numbers, locations by zone and model number for each installed detector.
 5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
 6. Response time on thermostats and flame detectors (if used).
 7. Technician's name, certificate number and date.
- B. After completion of all the tests and adjustments listed above, the contractor shall submit the following information to the Architect:
1. "As-built" conduit layout diagrams including wire color code and/or tag number.
 2. Complete "as-built" wiring diagrams.
 3. Detailed catalog data on all installed system components.
 4. Copy of the test report.
- C. Final tests and inspection shall be held in the presence of engineer. The contractor shall supply personnel and

required auxiliary equipment for this test without additional cost.

- D. The completed smoke detection system shall be tested to insure that it is operating properly. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period.
- E. Before final acceptance of work, the contractor shall deliver five copies of a composite "Operating and Shop Maintenance Manual." Each manual shall contain, but not be limited to: a statement of guarantee including date of termination and name and phone number of the person to be called in the event of equipment failure.
- F. Individual factory issued manuals shall contain all technical information on each piece of equipment installed. In the event such manuals are not obtainable from the factory, it shall be the responsibility of the contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals.

3.3 INSTALLATION

- G. Control and other panels shall be mounted with sufficient clearance for observation and testing.
- H. All fire alarm junction boxes must be clearly marked for easy identification as indicated in 16195. All wiring shall be in conduit unless noted otherwise on the contract documents or in the specifications. Flexible connectors shall be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels shall be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system.
- I. Fire alarm pull stations and horns installed in finished areas shall be mounted semi-flush and may be surface mounted in non-finished areas. Smoke detectors and thermal detectors shall be mounted on a recess mounted junction box in finished areas and to surface mounted junction boxes in non-finished areas.

- J. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be permitted in fire alarm conduits. Wiring splices are to be avoided to the extent possible, and if needed they must be made only in junction boxes and shall be crimp connected. Transposing or changing color coding of wires shall not be permitted. Wire nut-type connections are not acceptable. All conductors in conduit containing more than one wire shall be labeled on each end with "E-Z markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drop is off directly opposite to its terminal. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
- K. Install manual station flush mounted with operating handle 48 inches maximum above floor. Install audible and visual signal devices no more than 96 inches above highest floor level within the space or 6 inches below the ceiling, whichever is lower.
- L. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- M. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, panels, duct smoke detectors, and other auxiliary supervised devices.
- N. Automatic Detector Installation: NFPA 72.
- O. All locker room fire alarm devices shall be provided with protective wire guards.
- J. Fire alarm system cable shall be plenum rated, with red outer coloring. All cable drops to devices shall be in conduit (concealed in walls). Cabling installed in open ceiling spaces shall be type FPLP, low smoke, fire resistant, with red coloring. Cabling shall be per manufacturers recommendation, and shall be able to power the strobes and horn/strobes together, or independently.
- K. Install fire alarm cable in ceiling spaces to avoid damage. Use bridle rings and other similar means of support (lay-in ceiling areas).

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- L. Cabling to the Fire Alarm Control Panel and drops to devices shall be in recessed conduit.
- M. Fire alarm cabling in exposed ceiling spaces and above drywall ceiling areas shall be in conduit. Conduit used for fire alarm system shall have couplings and junction boxes painted red.

END OF SECTION 16721