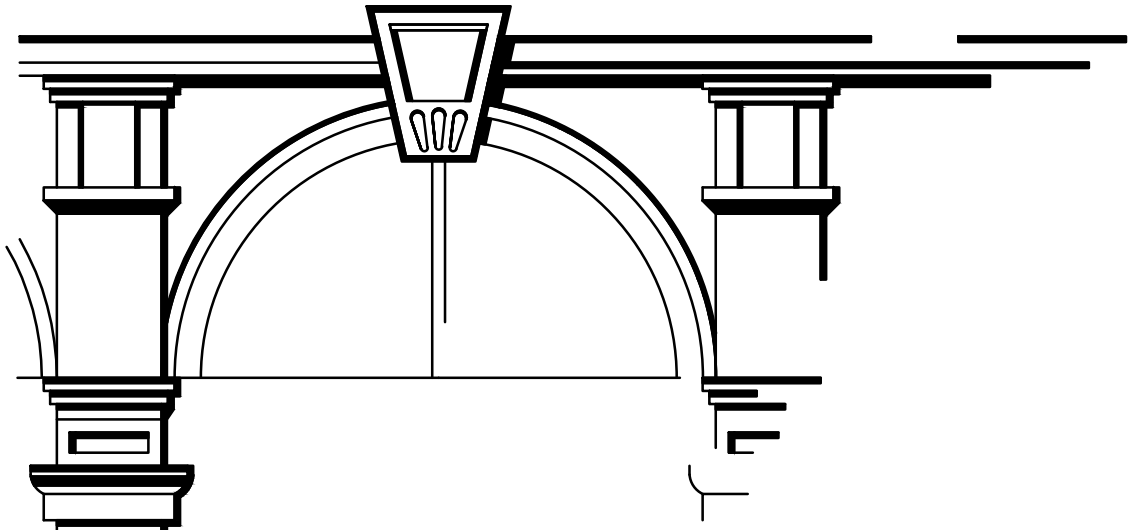

Maze
Design , Inc.

FAYETTE COUNTY SCHOOL CORPORATION

RENOVATION

EVERTON ELEMENTARY SCHOOL

CONNERSVILLE, IN

PROJECT #2127-1

AUGUST, 2021

PROJECT MANUAL

BIDDING REQUIREMENTS
CONDITIONS OF THE CONTRACT
SPECIFICATIONS

FOR

Renovation
Everton Elementary School
Connersville, IN
PROJECT 2127-1

MAZE DESIGN, INC.
124 South 8th Street
Richmond, Indiana 47374
Phone: (765)962-1300

Date: August 2021

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DIVISION 8: DOORS AND WINDOWS

DIVISION 9: FINISHES

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Division 26 - Electrical

Division 28 – Electronic Safety and Security

END OF INDEX

INVITATION TO BID

Issued By:
MAZE DESIGN, INC.
124 South 8th Street
Richmond, Indiana 47374
(765) 962-1300

1. You are invited to bid on a Prime Contract for the following project:

   Renovation
   Everton Elementary School
   2440 E. Everton Road
   Connersville, IN
   PROJECT 2127-1

2. Bids will be received for a Single Prime Contract consisting of all trades including General Construction, Heating Ventilating and Air Conditioning Construction, Electrical Construction.

3. Fayette County School Corporation will receive Bids until 2**:00 PM EST on September 10th, 2021**, at the Administration Building, 1401 Spartan Drive, Connersville, Indiana 47331. Bids will be opened publicly and read aloud immediately after specified closing time. All interested parties are invited to attend. Bids received after the specified closing time will be logged in with time of receipt, opened, read aloud, and forwarded for appropriate action by the Board, with full reservation of the Board to reject any or all Bids due to the lateness.

4. A mandatory Pre-bid conference is scheduled for **September 3rd, 2021 at 3:00 p.m.** at the project site.

5. Bidding Documents may be examined at the Engineer's office:

   Maze Design, Inc.
   124 South 8th Street
   Richmond, Indiana 47374

6. Bidding Documents may be obtained at Eastern Engineering Plan room www.easternengineering.com at contractors cost.

7. Bid security in the amount of five percent (5%) of the bid, must accompany each Bid in accordance with the Instructions to Bidders.

8. Guaranty Bonds in the form of a Performance Bond and a Labor and Material Payment Bond, in an amount equal to one hundred percent (100%) of the Contract Sum, will be required.

9. **SUBMISSION OF BIDS**

The Bid, bid security, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party indicated below and shall be identified with the Project name, division of work and the Bidder's name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

Scott Collins
Fayette County School Corporation
Administration Building
1401 Spartan Drive
Connersville, Indiana 47331

INSTRUCTIONS TO BIDDERS

ARTICLE 1
DEFINITIONS

1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement and Invitation to Bid, Instructions to Bidders, the bid forms, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions, of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

1.3 Addenda are written or graphic instruments issued by the Engineer prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.4 A Bid is a complete and properly signed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.8 A Bidder is person or entity who submits a Bid.

1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2
BIDDER'S REPRESENTATIONS

2.1 The Bidder by making a Bid represents that:

2.1.1 The Bidder has read and understands the Bidding Documents and the Bid is made in accordance therewith.

2.1.2 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, for other portions of the Project, if any, being bid concurrently or presently under construction.

2.1.3 Bidders are requested to visit the site, compare the drawings and specifications with any work in place, and inform themselves of all conditions, including other work, if any, being performed. Failure to visit the site will in no way relieve the successful bidder from necessity of furnishing any materials or performing any work that may be required to complete work in accordance with drawings without additional cost to Owner.

2.1.4 By submitting a Bid, the Bidder agrees that he has examined the site, the Specifications and Drawings, all other bidding documents and, where the specifications require, a given result to be produced in any part of the work, that the specifications and drawings are adequate and the required result can be produced under the specifications and drawings.

2.1.5 No claim for any extra will be allowed because of alleged impossibilities in the production of the results specified or because of inadequate or improper drawings and specifications.

2.1.6 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

2.2 PRE-BID CONFERENCE

2.2.1 A pre-bid conference will be held at the project site
2440 E. Everton Road, Connersville, IN 47331
on Friday, September 3rd, 2021, at 3:00 p.m. Bidders are required to attend.

ARTICLE 3
BIDDING DOCUMENTS

3.1 COPIES

3.1.1 Bidders may obtain complete sets of the Bidding Documents From Eastern Engineering Plan room www.easternengineering.com at contractors cost.

3.1.2 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Engineer assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 In making copies of the Bidding Documents available on the above terms, the Owner and the Engineer do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant permission for any other use of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Engineer errors, inconsistencies or ambiguities discovered.

3.2.2 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

3.3.2 No substitutions will be considered prior to receipt of Bids unless written request for approval has been received by the Engineer at least seven days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work including changes in the work of other contracts that incorporation of the proposed substitution would require shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Engineer's decision of approval or disapproval of a proposed substitution shall be final.

3.3.3 If the Engineer approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

3.3.4 Substitutions will be considered after the Contract award when request for approval is submitted in accordance with Section

01631, Product Substitutions.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the issuing office to have received a complete set of Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4
BIDDING PROCEDURE

4.1 FORM AND STYLE OF BIDS

4.1.1 Bids must be submitted on Indiana State Form No. 96 as prescribed by the State Board of Accounts of Indiana. This Form may be obtained on the internet at http://www.in.gov/sboa/files/Form96.pdf.
A separate financial statement is required by Indiana State Form No. 96 on contracts of $100,000.00 or more. In addition to State Form No. 96, Bidders must also submit Bid Form 96 Supplement which is included with the Bidding Documents. In the space provided for the Bid amount on State Form No. 96, enter the following; "SEE BID FORM 96 SUPPLEMENT." Bidders are to provide Bid amounts on Bid Form 96 Supplement.

4.1.2 All blanks on the bid form shall be filled in by typewriter or manually in ink.

4.1.3 Where so indicated by the makeup of the bid form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.

4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.4.1.5 Materials supplied for this project are exempt from Indiana
state sales tax.

4.1.6 All Bids submitted shall be based on the established minimum wage rates included with the Bidding Documents.

4.1.7 All respective Alternates shall be bid. If no change in the Base Bid is required, indicate no change.

4.1.8 Each Bid shall include the legal name of the Bidder and be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

4.2 BID SECURITY

4.2.1 Each Bid shall be accompanied by a bid security pledging that the Bidder will enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.

4.2.2 Bid security shall be a satisfactory bid bond, certified check or bank draft for the amount of five percent of the Bid, including all add alternates. If a bid bond is used, it shall be written on AIA Document A310, Bid Bond, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

4.2.3 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

4.3 SUBMISSION OF BIDS

4.3.1 The Bid, bid security, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party indicated below and shall be identified with the Project name, division of work and the Bidder's name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

Scott Collins
Fayette County School Corporation
Administration Building
1401 Spartan Drive
Connersville, Indiana 47331

4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the specified closing time will be logged in with time of receipt, opened, read aloud, and forwarded for appropriate action by the Board, with full reservation of the Board to reject any or all Bids due to the lateness.

4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

4.3.4 Oral, telephonic or telegraphic Bids are invalid and will not receive consideration.

4.4 MODIFICATION OR WITHDRAWAL OF BID

4.4.1 A Bid may not be withdrawn or canceled by the Bidder for a period of sixty (60) days following the time and date designated for the receipt of Bids and each Bidder so agrees in submitting a Bid.

4.4.2 Bids may be withdrawn prior to the time and date designated for receipt of Bids. Withdrawn Bids may not be resubmitted.

ARTICLE 5
CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

5.1.1 Bids received on time will be opened publicly and will be read aloud. All interested parties are invited to attend.

5.2 REJECTION OF BIDS

5.2.1 The Owner shall have the right to reject any or all Bids, reject a Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or reject a Bid which is in any way incomplete or irregular.

5.3 ACCEPTANCE OF BID (AWARD)

5.3.1 It is the intent of the Owner to award a Contract to the lowest responsible Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities or irregularities in a Bid received and to accept the Bid which, in the Owner's judgement, is in the Owner's own best interests.

5.3.2 The Owner shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6
POST-BID INFORMATION

6.1 SUBMITTALS

6.1.1 The two apparent low Bidders (identified by the Engineer) shall complete and submit in duplicate, to the Engineer, the Subcontractors and Materials List included with the Bidding Documents, within one day following the bid receipt date.

ARTICLE 7
PERFORMANCE BOND AND PAYMENT BOND

7.1 Performance and payment bonds covering the faithful

performance of the Contract and payment of all obligations arising thereunder will be required. Bonds may be secured through the Bidder's usual sources. Bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

7.2 The Bidder shall deliver the required bonds to the Owner prior to or with the submission of the executed Agreement, or if the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Paragraph 7.2.

7.3 The Bidder 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.

7.4 Bonds shall remain in full force and effect for a period of one year after the date of final acceptance of the Work.

ARTICLE 8
PERMITS

8.1 The Contractors shall obtain all building and other permits and inspection by governing agencies.

ARTICLE 9
FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

9.1 FORM TO BE USED

9.1.1 The Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum. Payment Terms shall be 45 days after pay request are submitted. Pay request shall be submitted Monthly.

9.1.2 It is the Owners intent to award the bid on 9/14/2021 at the school boards meeting.

9.1.3 Contractor shall start submittals and order of material upon award of bid.

ARTICLE 10
CONTRACTOR'S INSURANCE

10.1 Insurance requirements are specified in the General and Supplementary Conditions.

ARTICLE 11
OPEN COMPETITION

11.1 Where in these specifications, certain materials, trade names

or articles of certain manufacture are mentioned, it is done for the express purpose of establishing a basis of durability and efficiency and not for the purpose of the limiting of competition. Other materials may be used, by following the procedures outlined in Section 1 of these specifications.

END OF SECTION

BID FORM 96 SUPPLEMENT

BID TO: Board of Trustees
Fayette County School Corporation
Administration Building
1401 Spartan Drive
Connersville, IN 47331

BID FROM: _____

Address _____

City / State _____

Telephone No. _____

BID FOR:

Renovation
Everton Elementary School
2440 E. Everton Road
Connersville, IN 47331
PROJECT 2127-1

The Undersigned, having visited the site of proposed construction of this project, and having familiarized himself with local conditions affecting the cost of the Work and with all requirements of the Contract Documents and Addenda thereto as prepared by Maze Design, Inc., hereby offers to furnish all labor and materials required by the Contract Documents and Addenda thereto for the completion of the Contracts below for which an amount is provided:

BID SCHEDULE

Base Bids

General Contract Base Bid:

_____ Dollars ($_____)

ADDENDA RECEIVED

Receipt of Addendum Nos. _____, is hereby acknowledged.

BID ACCEPTANCE

If written notice of the acceptance of this Bid is received by the Undersigned within 60 days after the date for opening of Bids or any time thereafter before this Bid is withdrawn, the Undersigned will, execute the required Agreement and furnish Performance and Payment Bonds in accordance with the Contract Documents and Bid as accepted.

If Bidder is an individual complete the blanks in the following box.

IN TESTIMONY WHEREOF, the Bidder (an individual) has hereunto set his hand this _____ day of _____ 20____.

Individual _____

If Bidder is a partnership complete the blanks in the following box.

IN TESTIMONY WHEREOF, the Bidder (a Partnership) have hereunto set their hands this _____ day of _____ 20____.

Name of Partnership _____

Name of Partners _____

_____

If Bidder is a Corporation complete the blanks in the following box.

IN TESTIMONY WHEREOF, the Bidder (a Corporation) has caused this Bid to be signed by its President and Secretary this _____ day of _____ 20____.

Name of Corporation _____

President _____

Secretary _____

CONTRACTOR'S BID FOR PUBLIC WORK – FORM 96

PART I
(To be completed for all bids. Please type or print)

Date:_____

1. Governmental Unit (Owner):_____
2. County :_____
3. Bidder (Firm):_____

   Address:_____

   City/State:_____
4. Telephone Number:_____
5. Agent of Bidder (if applicable):_____

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of _____ (Governmental Unit) in accordance with plans and specifications prepared by _____ _____ and dated _____ for the sum of _____ $_____

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit basis, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS
(If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

ACCEPTANCE

The above bid is accepted this _____ day of _____, _____, subject to the following conditions: _____

_____

Contracting Authority Members:

_____ _____

_____ _____

_____ _____

PART II
(For projects of $100,000 or more – IC 36-1-12-4)

Governmental Unit: _____

Bidder (Firm) _____

Date: _____

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

Contract Amount	Class of Work	Completion Date	Name and Address of Owner

2. What public works projects are now in process of construction by your organization?

Contract Amount	Class of Work	Expected Completion Date	Name and Address of Owner

3. Have you ever failed to complete any work awarded to you? _____ If so, where and why?

_____

_____

_____

4. List references from private firms for which you have performed work.

_____

_____

_____

_____

_____

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. (Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)

2. Please list the names and addresses of all subcontractors (i.e. persons or firms outside your own firm who have performed part of the work) that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

SECTION III CONTRACTOR'S FINANCIAL STATEMENT

Attachment of bidder's financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder's capability for completing the project if awarded.

SECTION IV CONTRACTOR'S NON – COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee, gift, commission or thing of value on account of such sale.

SECTION V OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated at _____ this _____ day of _____, _____

_____
(Name of Organization)

By_____

_____
(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF _____)
) ss
COUNTY OF_____)

Before me, a Notary Public, personally appeared the above-named _____ and swore that the statements contained in the foregoing document are true and correct.

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

_____
Notary Public

My Commission Expires:_____

County of Residence:_____

Form No. 96 (Revised 2005)

BID OF

_____
(Contractor)

_____
(Address)

_____

FOR

PUBLIC WORKS PROJECTS

OF

_____

_____

_____

Filed _____, _____

Action taken _____

_____

SUBCONTRACTORS AND MATERIALS LIST

REQUIREMENTS

1.1 The single prime contractor shall submit with their bid a completed prime subcontractors and materials list. All applicable blanks must be completed.

1.2 The Bidder will be required to establish to the satisfaction of the Engineer and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

1.3 Prior to the award of the Contract, the Engineer will notify the Bidder in writing if either the Owner or Engineer after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Engineer has reasonable objection to a proposed person or entity, the Bidder may at the Bidder's option (1) withdraw the Bid, or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

1.4 Persons and entities proposed by the Bidder and to whom the Owner and Engineer have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Engineer.

SINGLE PRIME CONTRACT

Bidder: _____

Project Name & Number: _____

Sub Contractor

Finishes

Masonry _____

Painting _____

GENERAL CONDITIONS

REQUIREMENTS

1.1 General Conditions shall be AIA Document A201, entitled, "General Conditions of the Contract for Construction".

SUPPLEMENTARY CONDITIONS

The following supplements shall be part of the "General Conditions of the Contract for Construction.
The term Engineer shall be substituted for the term Architect.

Permits, Fees and Notices

The Contractor will be required to observe all ordinances that may in any way affect the nature of the work he is doing and shall be solely responsible for any violations thereof. Also, he shall observe any rules or regulations of the State of Indiana and/or local health officials, and must take such precautions as necessary to avoid unsafe unsanitary conditions.

Indemnification

The Contractor agrees to indemnify and save harmless the Owner, Lessee, Engineer, their agents and employees, from and against all loss or expense (including costs and attorneys' fees) by reason of liability imposed by law upon the Owner or Lessee, for damages because of bodily injury, including death at any time resulting therefrom sustained by any person or persons or on account of damage to property, including loss of use thereof, arising out of or in consequence of the performance of this work, provided such injury to persons or damage to property is due or claimed to be due to negligence of the Contractor, be construed to include any and all successors to the currently named Owner, irrespective of how such succession occurred and/or who or what the successor(s) is or are.

FINAL COMPLETION AND FINAL PAYMENT

Final Payment, including all escrowed principal and escrowed income, shall be paid within ninety-one (91) days after the date of Substantial Completion, subject to the requirements of Subparagraph 9.10.2. If at the time of said payment there remain uncompleted minor items, an amount equal to two hundred percent (200%) of the value of each item as determined by the Engineer shall be withheld until the item is completed. The cost for the Engineer's estimate and other efforts necessary to establish the value of the incomplete work will be deducted from the remaining funds owed to the Contractor.

INSURANCE AND BONDS

Contractor's Liability Insurance

The insurance shall be written for not less than the following limits, or greater if required by law:

1. Worker's Compensation:

(a) State		Statutory
(b) Applicable Federal (e.g., Longshoremen's)		Statutory
(c) Employer's Liability:	$ 100,000	per Accident
	$ 100,000	Disease, Policy Limit
	$ 100,000	Disease, Each Employee

2. Comprehensive or Commercial General Liability (including Premises-Operations; Independent Contractor's Protective; Products and Completed Operations; Broad Form Property Damage):

   (a) Bodily Injury:

$ 500,000	Each Occurrence
$ 1,000,000	Aggregate

   (b) Property Damage:

$ 1,000,000	Each Occurrence
$ 1,000,000	Aggregate

   (c) Products and Completed Operations to be maintained for one year after final payment.

   (d) Property Damage Liability Insurance shall provide X, C, and U coverage.

   (e) Broad Form Property Damage Coverage shall include Completed Operations.

3. Contractual Liability:
   (a) Bodily Injury:

$ 500,000	Each Occurrence
$ 1,000,000	Aggregate

   (b) Property Damage:

$ 500,000 Each Occurrence

$ 1,000,000 Aggregate

4. Personal Injury, with Employment Exclusion deleted:

$ 500,000 Aggregate

5. Business Auto Liability (including owned, non-owned, and hired vehicles):

(a) Bodily Injury:

$ 500,000 Each Person

$ 1,000,000 Each Occurrence

(b) Property Damage:

$ 500,000 Each Occurrence

7. Umbrella Excess Liability:
$ 3,000,000 over primary insurance

Performance Bond and Payment Bond

The Contractor shall furnish a Performance Bond and Payment Bond covering faithful performance of the Contract and payment of obligations arising thereunder. 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. Bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

The Contractor shall deliver the required bonds to the Owner prior to or with the submission of the executed Agreement, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered.

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.

Bonds shall remain in full force and effect for a period of one year after the date of final acceptance of the Work.

Equal Opportunity

The Contractor shall maintain policies of employment as follows:

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 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.

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

SECTION 01011 - SUMMARY OF WORK - SINGLE PRIME CONTRACT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT IDENTIFICATION

A. The Project consists of Renovation Everton Elementary School per Contract Documents:

Renovation
Everton Elementary School
2440 E. Everton Rd.
Connersville, IN 47331
PROJECT 2127-1

For: The Fayette County School Corporation,
1401 Spartan Drive, Connersville, IN 47331
Contract documents prepared by Maze Design, Inc.
Dated August 2021.

B. Single Prime Contract, Represents a contract that combines all construction activities performed on the project under one Single Prime Contract. The Single Prime Contract for this project includes

All Construction, Labor and material for the renovation of Everton Elementary School per the contract documents.

1.3 WORK SEQUENCE

A. Education takes highest priority, scheduling will be established to minimize any interruption in the educational process.

The Owner will work closely with the Contractor to move the project as expedient as possible.

Phase 1 work for the new concrete foundation shall start on October 23rd, 2021 and the new foundation completed and area cleaned for owner use on or before October 31st, 2021.

Phase 2 new Masonry divider wall shall start on December 23rd, 2021 and be completed by January 12th, 2022.

Phase 3 balance of remaining work shall start on December 23rd, 2021 and all work must be completed by March 25th, 2022.

1.4 CONTRACTORS USE OF PREMISES

A. General: The Contractor shall limit their use of the premises to construction activities in areas indicated. All dumpster locations must be approved by owner. Repair of any damage to lawn, walks drives and other improvements shall be repaired by contractor.

(1) Keep driveways and entrances serving the premises clear and available to the Owner and the Owner's employees at all times. Coordinate areas available for parking or storage of materials with Owner's representative. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

1.5 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy the site and existing building for School during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations. Contractor shall provide temporary self-contained toilets for employees.

1.6 PROVISIONS FOR CONTRACTORS EMPLOYEES

a. It is required that all construction employees comply with the following rules during school hours and school activities. Said rules shall be posted at the job site.

1. No employees are to eat in the occupied school premises.
2. Construction employees are not to be within areas used by students during school hours without express approval by the Principal.
3. There is to be no smoking on school property.
4. No coffee breaks, loafing, etc., will be tolerated in areas occupied by school.
5. All construction personnel will conduct themselves in an unimpeachable manner while on the construction site, including proper language, etc.
6. All requirements of Occupational Safety and Health Act will be followed implicitly.
6. The contractor shall have all employees complete and submit a background check prior to working on site. Verify type with Owner.

END OF SECTION 01011

SECTION 01020 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing handling and processing allowances.

B. Types of allowances required include the following:

1. Lump sum allowances.
2. Contingency allowances.

C. Procedures for submitting and handling Change Orders are included in Section "Change Order Procedures."

1.3 SELECTION AND PURCHASE

A. At the earliest feasible date after Contract award, advise the Engineer of the date when the final selection and purchase of each product or system described by an allowance must be completed in order to avoid delay in performance of the Work.

1. When requested by the Engineer, obtain proposals for each allowance for use in making final selections; include recommendations that are relevant to performance of the Work.
2. Purchase products and systems as selected by the Engineer from the designated supplier.

1.4 SUBMITTALS

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

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

1.5 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed for the Owner's purposes, and only by Change Orders which designate amounts to be charged to the allowance.

1. The Contractor's related costs for products or equipment ordered by the Owner under the contingency allowance, including delivery, installation, taxes, insurance, equipment rental, and similar costs are not part of the Contract Sum.
2. Change Orders authorizing use of funds from the contingency allowance will include the Contractor's related costs and reasonable overhead and profit margins.
3. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.
4. Contractor mark-up on allowance items purchased shall be limited to 5% of the purchase / sub-contractors cost.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect products covered by an allowance promptly upon delivery for damage or defects.

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

Allowance No. 1 General: General Contractor shall include a Contingency Allowance of $10,000.00 for use upon the Owner's instructions.

END OF SECTION 01020

SECTION 01027 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Prime Contractor shall prepare its Schedule of Values for its Work.

1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

    a. Contractor's construction schedule.
    b. Application for Payment form.

2. Submit the Schedule of Values to the Engineer at the earliest feasible date, but in no case later than 7 days before the date scheduled for submittal of the initial Application for Payment.

B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

1. Schedule of Value Form: Use form included at the end of this section.
2. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.
3. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
4. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide

separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

5. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

    a. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in- place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

6. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Engineer and paid for by the Owner.

    1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times: Each progress payment date is the 6th day of the month. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement. Owner shall have 31 days for payment to be submitted to contractor.

C. Payment Application Forms: Use AIA Document G 702 and Continuation Sheets G 703, as the form for Application for Payment. Use original documents; copies will not be accepted.

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

    1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
    2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the

construction period covered by the application.

E. Transmittal: Submit four executed copies of each Application for Payment to the Engineer by means ensuring receipt within 24 hours; all copies shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer.

F. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from subcontractors or sub- subcontractors and suppliers for the construction period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include but are not limited to the following:

1. Schedule of Values.
2. Contractor's Construction Schedule (preliminary if not final).
3. Copies of building permits
4. Certificates of insurance and insurance policies.

H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work. Administrative actions and submittals that shall precede or coincide with this application include but are not limited to the following:

1. Occupancy permits and similar approvals.
2. Warranties (guarantees) and maintenance agreements.
3. Test/adjust/balance records.
4. Maintenance instructions.
5. Start-up performance reports.
6. Change-over information related to Owner's occupancy, use, operation and maintenance.

7. Final cleaning.
8. List of incomplete Work, recognized as exceptions to Engineer's Certificate of Substantial Completion.

I. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include but are not limited to the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Removal of temporary facilities and services.
7. Removal of surplus materials, rubbish and similar elements.
8. Change of door locks to Owner's access.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01027

SECTION 01035 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Single Prime Contracts: Provisions of this Section apply to the Work of prime contractor.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 1 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Division 1 Section "Submittals" for requirements for the Contractor's Construction Schedule.
3. Division 1 Section "Application for Payment" for administrative procedures governing applications for payment.

1.3 MINOR CHANGES IN THE WORK

A. Supplemental instructions authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Engineer on AIA form G710, Architect's Supplemental Instructions.

1.4 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Engineer, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.

1. Proposal requests issued by the Engineer are for

information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.

2. Unless otherwise indicated in the proposal request, within 20 days of receipt of the proposal request, submit to the Engineer for the Owner's review an estimate of cost necessary to execute the proposed change.

    a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Engineer.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Section "Product Substitutions" if the proposed change in the Work requires the substitution of one product or system for a product or system specified.

C. Proposal Request Form: Use AIA Document G 709 for Change Order Proposal Requests.

1.5 ALLOWANCES

A. Allowance Adjustment: Base each Change Order Proposal Request for an allowance cost adjustment solely on the difference between the actual purchase amount and the allowance, multiplied by the final measurement of work-in-place, with reasonable allowances, where applicable, for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in the purchase amount only where indicated as part of the allowance.
2. When requested, prepare explanations and documentation to substantiate the margins claimed.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit, within 20 days of receipt of the change order or construction change directive authorizing work to proceed. Claims submitted later than 20 days will be rejected.

1. The Change Order cost amount shall not include the Contractor's or Subcontractor's indirect expense except when it is clearly demonstrated that either the nature or scope of work required was changed from that which could have been foreseen from the description of the allowance and other information in Contract Documents.
2. No change to the Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Engineer may issue a Construction Change Directive on AIA Form G714, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Change Order Proposal Request, the Engineer will issue a Change Order for signatures of the Owner and Contractor on AIA Form G701, as provided in the Conditions of the Contract.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01035

SECTION 01041 - PROJECT COORDINATION –PRIME CONTRACT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies minimum administrative and supervisory requirements necessary for coordination on the Project to be fulfilled by the single prime Contractor.

B. Field engineering is included in Section "Field Engineering".

C. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".

D. Requirement for the Contractor's Construction Schedule is included in Section "Submittals."

1.3 COORDINATION

A. Coordination: The Prime Contractor shall be responsible for overall coordination and shall coordinate Subcontractor’s construction activities with those of other Subcontractors and other entities involved to assure efficient and orderly installation of each part of the Work.

1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, Prime contractor shall schedule the construction activities in the sequence required to obtain the best results.
2. Where availability of space is limited, Prime contractor shall coordinate installation of different components with other Subcontractors to assure maximum accessibility for required maintenance, service, and repair.
3. Prime contractor shall make adequate provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each

party involved outlining special procedures required for coordination. Include items such as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

C. Administrative Procedures: Prime contractor shall coordinate scheduling and timing of its administrative procedures with other construction activities and activities of other Subcontractors to avoid conflicts and ensure orderly progress of the Work.

D. Conservation: Prime contractor shall coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare and submit Coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the interrelationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Comply with requirements contained in Section "Submittals".
4. Preparation Responsibility: Preparation of Coordination Drawings is the responsibility of the prime Contractor.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: The prime contractor shall require the installer of each major component to

inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

1. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject incorrect, damaged and defective items.

2. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

C. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.

D. Recheck measurements and dimensions, before starting each installation.

E. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

F. Enclosure of the Work: Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

G. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Engineer for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure freedom from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Prime contractor shall supervise its construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation,
21. Improper lubrication,
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION 01041

SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division-15 and Division-16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

C. Demolition of selected portions of the building for alterations is included in Section "Selective Demolition."

1.3 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials that match existing adjacent materials to the fullest extent possible with regard to visual effect. Notify Engineer of existing materials which cannot be matched prior to proceeding. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
4. Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

    a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.

4. Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 01045

SECTION 01095 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.

C. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Engineer, requested by the Engineer, and similar phrases.

D. Approved: The term approved, when used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: The term install describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. Provide: The term provide means to furnish and install, complete and ready for the intended use.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16-Division format and MASTERFORMAT numbering system.

B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and other uncertainties to the Engineer for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or

quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to 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, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the Text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.5 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01095

SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings.

B. Construction schedules are specified in other Division-1 Sections.

1.3 PRE-CONSTRUCTION CONFERENCE

A. Contractor to schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than 10 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Engineer and their consultants, all Sub Contractors and their superintendents, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule.
2. Critical Work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents.
7. Submittal of Shop Drawings, Product Data and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Office, Work and storage areas.

11. Equipment deliveries and priorities.
12. Safety procedures.
13. First aid.
14. Security.
15. Housekeeping.
16. Working hours.

1.4 PRE-INSTALLATION CONFERENCES

A. Conduct a pre-installation conference at the site as required:

1.5 COORDINATION MEETINGS

A. Conduct Project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 PROGRESS MEETINGS

A. Conduct bi-weekly progress meetings at the Project site. Notify the Owner and Engineer of scheduled meeting times. Coordinate dates of meetings with preparation of the payment request. The Contractor for General Construction is responsible for coordinating the meetings and taking minutes.

B. Attendees: In addition to representatives of the Owner and Engineer, each contractor, each major subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
2. Review the present and future needs of each entity present, including such items as:

    a. Interface requirements.
    b. Time.
    c. Sequences.
    d. Deliveries.
    e. Off-site fabrication problems.
    f. Access.
    g. Site utilization.
    h. Temporary facilities and services.
    i. Hours of Work.
    j. Hazards and risks.
    k. Housekeeping.
    l. Quality and Work standards.
    m. Change Orders.
    n. Documentation of information for payment requests.

D. Reporting: No later than 5 days after each progress meeting date, the Contractor for General Construction will have distributed copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

    1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including;

1. Contractor's construction schedule.
2. Submittal schedule.
3. Daily construction reports.
4. Shop Drawings.
5. Product Data.
6. Samples.

B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits.
2. Applications for payment.
3. Performance and payment bonds.
4. Insurance certificates.
5. List of Subcontractors.

C. The Schedule of Values submittal is included in Section "Applications for Payment."

D. Inspection and test reports are included in Section "Quality Control Services."

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related

activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

    a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

    a. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.
    b. If an intermediate submittal is necessary, process the same as the initial submittal.
    c. Allow two weeks for reprocessing each submittal.
    d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
2. Include the following information on the label for processing and recording action taken.

    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Number and title of appropriate Specification Section.
    i. Drawing number and detail references, as appropriate.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals

received from sources other than the Contractor will be returned without action.

D. All submittals shall be submitted to the Engineer by Email in PDF Format. Material Samples shall be submitted and delivered to the Engineers office as specified.

1. On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. See Section 01315 for required CPM Schedule.

1.5 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the schedule no later than 10 days after the date required for establishment of the Contractor's construction schedule.

1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
2. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:

a. Scheduled date for the first submittal.
b. Related Section number.
c. Submittal category.
d. Name of subcontractor.
e. Description of the part of the Work covered.
f. Scheduled date for Engineer's final release or approval.

B. Distribution: Following response to initial submittal, print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in

construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.6 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording the following information concerning events at the site; and submit one copy to the Engineer at weekly intervals:

1. List of subcontractors at the site.
2. Approximate count of personnel at the site.
3. High and low temperatures, general weather conditions.
4. Accidents and unusual events.
5. Meetings and significant decisions.
6. Stoppages, delays, shortages, losses.
7. Meter readings and similar recordings.
8. Emergency procedures.
9. Orders and requests of governing authorities.
10. Change Orders received, implemented.
11. Services connected, disconnected.
12. Equipment or system tests and start-ups.
13. Partial Completions, occupancies.
14. Substantial Completions authorized.

1.7 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.
6. Sheet Size: Except for templates, patterns and similar full- size Drawings, submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 36" x 48".
7. Initial Submittal and Resubmittals: Submit one correctable translucent reproducible and one blue- or black-line print if possible, or seven blue or black-

line prints for the Engineer's review; the reproducible print will be returned.
8. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

C. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

1. Preparation of coordination Drawings is specified in section "Project Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
2. Submit coordination Drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

1.8 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

a. Manufacturer's printed recommendations.
b. Compliance with recognized trade association standards.
c. Compliance with recognized testing agency standards.
d. Application of testing agency labels and seals.
e. Notation of dimensions verified by field measurement.
f. Notation of coordination requirements.

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
3. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.

4. Submittals:
   a. Submit 7 copies of each required submittal.

   b. All submittals shall also be submitted to the Engineer by Email in PDF Format. Material Samples shall be submitted and delivered to the Engineers office as specified.

   c. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

   a. Do not proceed with installation until an approved copy of Product Data is in the installer's possession.
   b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.9 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

   1. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Engineer's Sample. Include the following:

      a. Generic description of the Sample.
      b. Sample source.
      c. Product name or name of manufacturer.
      d. Compliance with recognized standards.
      e. Availability and delivery time.

   2. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

      a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the

variations.
b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
c. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.

3. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

   a. Preliminary submittals will be reviewed and retained by the Engineer. The Engineer will return written response of selections and other actions.

4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.
5. Maintain sets of Samples, as returned, at the Project site, for quality comparisons throughout the course of construction.

   a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
   b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1. Field Samples specified in individual Sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.

   a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.10 ENGINEER'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
2. Final-But-Restricted Release: When submittals are marked "Make Corrections Noted," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
3. Returned for Resubmittal: When submittal is marked "Amend & Resubmit or Rejected - See Remarks," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

a. Do not permit submittals marked "Not Approved, Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.

4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing each Prime Contractor's selection of products for use in the Project.

B. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

C. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section "Product Substitutions."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms such are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

    a. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.

2. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational parts, whether

motorized or manually operated, that requires service connections such as wiring or piping.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime Contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate Contractors.
2. If a dispute arises between prime Contractors over concurrently selectable, but incompatible products, the Engineer will determine which products shall be retained and which are incompatible and must be replaced.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

a. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document

provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

    a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Engineer's decision will be final on whether a proposed product matches satisfactorily.

    a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Engineer will select the color, pattern and texture from the product line selected.

9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division-1 for allowances that control product selection, and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS:

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01600

SECTION 01631 - PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1. Single Prime Contracts: Provisions of this Section apply to the construction activities of prime Contractor.

B. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

C. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Materials and Equipment."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
2. Revisions to Contract Documents requested by the Owner or Engineer.
3. Specified options of products and construction methods included in Contract Documents.
4. The Contractor's determination of and compliance with

governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received the first application for payment. Requests received after this time may be considered or rejected at the discretion of the Engineer.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.
2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
b. Samples, where applicable or requested.
c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
f. Cost information, including a proposal of the net change, if any in the Contract Sum.
g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

3. Engineer's Action: Within one week of receipt of the

request for substitution, the Engineer will request additional information or documentation necessary for evaluation of the request. Within 2 weeks of receipt of the request, or one week of receipt of the additional information or documentation, which ever is later, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is timely, fully documented and properly submitted.
4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.
5. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot

be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.
11. Where a proposed substitution involves more than one prime Contractor, each Contractor shall cooperate with the other Contractors involved to coordinate the Work, provide uniformity and consistency, and to assure compatibility of products.

B. The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01631

SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.
2. Submittal of warranties.
3. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-2 through -16.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

    a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

B. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection

or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat inspection when assured that the Work has been substantially completed.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.

B. Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1. Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do

not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01700

SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for Project Record Documents.

B. Project Record Documents required include:

1. Marked-up copies of Contract Drawings.
2. Marked-up copies of Shop Drawings.
3. Maintenance Manuals.
4. Scan PDF set of As-Built Record Drawings

C. Specific record copy requirements that expand requirements of this Section are included in the individual Sections.

D. General project closeout requirements are included in Section "Project Closeout."

E. General requirements for submittal of Project Record Documents are included in Section "Submittals."

F. Contractor is responsible for obtaining, maintaining, and recording Project Record Document information for its own part of the Work. The Contractor for General Construction is responsible for coordination of Project Record Document information, where information from more than one prime Contractor is indicated to be integrated to form one combined record of the Work.

1.3 RECORD DOCUMENTS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure location; provide access to record documents for the Engineer's reference during normal working hours.

1.4 RECORD DRAWINGS

A. Mark-up Procedure: During the construction period, maintain a set of blue- or black-line white-prints of Contract Drawings and Shop Drawings for Project Record Document purposes.

1. Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

    a. Dimensional changes to the Drawings.
    b. Revisions to details shown on the Drawings.
    c. Depths of foundations below the first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order.
    k. Details not on original Contract Drawings.

2. Mark completely and accurately record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
3. Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.
4. Mark important additional information which was either shown schematically or omitted from original Drawings.
5. Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.
6. Submit the marked-up record set to the Engineer for Owner's records.
7. Submit CD containing electronic PDF as-built record prints at original full scale size.

1.5 MAINTENANCE MANUAL SUBMITTAL

A. When each construction activity that requires submittal of maintenance manuals is nominally complete, but before Substantial Completion, submit 3 copies of maintenance manuals specified.

1. Organize operating and maintenance manuals into suitable sets of manageable size.
2. Bind data into individual binders for each manual, properly identified on front and spine. For large manuals, provide an index sheet and thumb tabs for separate information categories.
3. Provide vinyl-covered, heavy-duty back cover mounted 3-ring slant type binders, 1" to 2" thick as required to contain information, sized for 8-1/2" x 11" paper with inside pockets or pocket folders for folded sheets.
4. In each maintenance manual include information specified in individual Specification Sections and the following:

    a. Emergency instructions.
    b. Spare parts list.
    c. Copies of specific warranties.
    d. Wiring diagrams.
    e. Recommended maintenance procedures and turn-around times.
    f. Inspection and system-test procedures.
    g. Copies of applicable Shop Drawings and Product Data.
    h. Listing of required maintenance materials and services.
    i. Names and addresses of sources of maintenance materials.
    j. Maintenance Drawings and diagrams.
    k. Precautions against improper maintenance and exposure.

5. Manuals for mechanical and electrical equipment items shall include the following additional information:

    a. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    b. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operation instructions.
    c. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
    d. Servicing instructions and lubrication charts and schedules.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 RECORDING

A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project. The Engineer may periodically review record documents to assure compliance with this requirement.

END OF SECTION 01720

SECTION 03300 - CAST-IN-PLACE CONCRETE

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 specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes, but is not limited to the following:

1. Foundations and footings.
2. Slabs-on-grade.
3. Foundation walls.
4. Equipment pads and bases.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 2 Section "Portland Cement Concrete Paving" for concrete paving and walks.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and others if requested by Engineer.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

D. Samples of materials as requested by Engineer, including

names, sources, and descriptions, as follows:

1. Fiber reinforcement.
2. Reglets.
3. Waterstops.
4. Vapor retarder/barrier.

E. Laboratory test reports for concrete materials and mix design test.

F. Material certificates in lieu of material laboratory test reports when permitted by Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 318, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

B. Concrete Testing Service: Engage a testing agency acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

D. 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.
2. For exposed-to-view concrete surfaces where legs 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).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless

otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, use limestone aggregates.
2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.

D. Water: Potable.

E. Fiber Reinforcement: Polypropylene fibers engineered and designed for secondary reinforcement of concrete slabs, complying with ASTM C 1116, Type III.

F. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

H. Water-Reducing Admixture: ASTM C 494, Type A.

I. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

J. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

2.4 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (22 gage) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

C. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.

D. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.

E. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:

1. Polyethylene sheet not less than 8 mils thick.

F. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.

G. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.

H. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

I. Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch thick to feathered edges.

J. Bonding Agent: Polyvinyl acetate or acrylic base.

K. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.
2. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.

C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:

1. 4000-psi, 28-day compressive strength; water-cement ratio, 0.45 maximum (non-air-entrained), 0.40 maximum (air-entrained).

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 2 inch and not more than 4 inches.
3. Slabs, concrete containing high-range water-reducing admixture (superplasticizer): Not more than 6 inches after adding admixture to site-verified 2 inch slump concrete.
4. Other concrete: Not more than 4 inches.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in Work.

F. Fiber Reinforcement: Add to mix at rate of 1.5 lb per cu. yd. unless otherwise recommended by manufacturer.

2.6 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:

a. 5.5 percent (severe exposure) for 1-1/2-inch maximum aggregate.
b. 6.0 percent (severe exposure) for 1-inch maximum aggregate.
c. 6.0 percent (severe exposure) for 3/4-inch maximum aggregate.
d. 7.0 percent (severe exposure) for 1/2-inch maximum aggregate.

E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.
2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades,

level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches.

3.4 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports

and as specified.

1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. 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.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Engineer.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings unless noted otherwise.
Bulkheads designed and accepted for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

F. Isolation Joints in Slabs-on-Grade: Construct isolation

joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

G. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
4. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.6 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Install dovetail anchor slots in concrete structures as indicated on drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without

causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by

high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.

1. After completing float finishing and before starting trowel finish, uniformly spread 25 lb of dampened nonslip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound.

D. Provide moisture curing by the following methods:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

F. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to

avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Engineer.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects

include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The General Contractor will employ a testing agency to perform tests and to submit test reports.

B. Sampling and testing for quality control during concrete placement shall include the following, as directed by Engineer.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
3. When total quantity of a given class of concrete is less than 50 cu. yd., Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.
4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. Test results will be reported in writing to Engineer, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at

28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03300

SECTION 04200 - UNIT MASONRY

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 includes the following:

1. Clay unit masonry in the form of brick.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 7 Section "Flashing and Sheet Metal" for exposed sheet metal flashing installed in masonry.

C. Products installed but not furnished under this Section include the following:

1. Steel lintels in unit masonry are specified in Division 5 Section "Metal Fabrications."
2. Wood nailers and blocking built into unit masonry are specified in Division 6 Section "Rough Carpentry."
3. Hollow metal frames in unit masonry openings are specified in Division 8 Section "Steel Doors and Frames."
4. Hollow metal frames in unit masonry openings are specified in Division 8 Section "Custom Hollow Metal Work."

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each different masonry unit, accessory, and other manufactured product indicated.

D. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.

1. Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.
2. Each material and grade indicated for reinforcing bars.
3. Each type and size of joint reinforcement.
4. Each type and size of anchors, ties, and metal accessories.

E. Material test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:

1. Mortar complying with property requirements of ASTM C 270.
2. Grout mixes. Include description of type and proportions of grout ingredients.

F. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

G. Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

H. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, telephone numbers, names of Engineers and Owners, and other information specified.

I. Results from tests and inspections performed by Owner's representatives will be reported promptly and in writing to Engineer and Contractor.

1.4 QUALITY ASSURANCE

A. Unit Masonry Standard: Comply with ACI 530.1/ASCE 6 "Specifications for Masonry Structures," except as otherwise indicated.

1. Revise ACI 530.1/ASCE 6 to exclude Sections 1.4 and 1.7; Parts 2.1.2, 3.1.2, and 4.1.2; and Articles 1.5.1.2, 1.5.1.3, 2.1.1.1, 2.1.1.2, and 2.3.3.6 and to modify Article 2.1.1.5 by deleting requirement for installing vent pipes and conduits built into masonry.

B. Inspecting Laboratory Qualifications: To qualify for

employment in performing tests and inspection specified in this Section, an independent testing laboratory must demonstrate to Engineer's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM C 1093, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the Work.

C. Preconstruction Testing: Owner will employ and pay a qualified independent testing laboratory to perform the following preconstruction testing indicated as well as other inspecting and testing services required by referenced unit masonry standard or indicated herein for source and field quality control:

1. Clay unit masonry tests: For each different clay masonry unit indicated, units will be tested per ASTM C 67.

D. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

G. Field-Constructed Mock-Ups: Prior to installation of unit masonry, erect sample wall panels to further verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work:

1. Locate mock-ups on site in locations indicated or, if not indicated, as directed by Engineer.
2. Build mock-ups for the following types of masonry in sizes of approximately 4 feet long by 4 feet high by full thickness, including face and backup wythes as well as accessories.

a. Each type of exposed unit masonry construction.

3. Where masonry is to match existing, erect panels parallel to existing surface.
4. Notify Engineer one week in advance of the dates and times when mock-ups will be erected.
5. Protect mock-ups from the elements with weather-resistant membrane.
6. Retain and maintain mock-ups during construction in undisturbed condition as standard for judging completed unit masonry construction.

a. When directed, demolish and remove mock-ups from Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

D. Cold-Weather Construction: Comply with referenced unit masonry standard for cold-weather construction and the following:

1. Do not lay masonry units that are wet or frozen.
2. Remove masonry damaged by freezing conditions.

E. Hot-Weather Construction: Comply with referenced unit masonry standard.

1.8 ALLOWANCES

A. As a basis for estimating, the Contractor shall figure the standard face brick costing $530.00 per thousand, delivered to the job site, unloaded and stored as directed by the Engineer. Should any of the selected face brick cost less than the amount specified, the Contractor is to make an allowance of the difference to the Owner, or shall expend said sum on the project as directed by the Engineer. Should the face brick cost more than the amount specified, the Owner shall pay the difference to the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.2 CLAY MASONRY UNITS

A. Face Brick Standard: ASTM C 216 and as follows:

1. Grade and Unit Compressive Strength: Provide units of

grade and minimum average net area compressive strength indicated below:

a. Grade SW.
b. Not less than the unit compressive strengths required to produce clay masonry construction of compressive strength indicated.

2. Type FBX (for general use in exposed masonry requiring minimum variations in size and color ranges).
3. Size: Provide bricks manufactured to the following actual dimensions within the tolerances specified in ASTM C 216:

a. Standard: 3-5/8 inches thick by 2-1/4 inches high

4. Shape units during manufacture as indicated below:

a. Molding.
b. Pressing.
c. Extruding.
d. Any method indicated above.

5. Application: Use where brick is exposed, unless otherwise indicated.
6. Wherever shown to "match existing," provide face brick of matching color, texture, and size as existing adjacent brickwork.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Masonry Cement: ASTM C 91.

1. For colored pigmented mortars use premixed colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations.
2. For colored aggregate mortars use masonry cement of natural color or white as required to produce mortar color indicated.

C. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this article, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.

D. Hydrated Lime: ASTM C 207, Type S.

E. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

F. Aggregate for Grout: ASTM C 404.

G. Water: Clean and potable.

2.4 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.

B. Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard for application indicated.

C. Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard, for wire ties and anchors in interior walls, unless otherwise indicated.

1. Wire Diameter: 0.1875 inch.

D. Galvanized Steel Sheet: ASTM A 366 (commercial quality) cold-rolled carbon steel sheet, hot-dip galvanized after fabrication to comply with ASTM A 525, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors.

1. Thickness of Steel Sheet Galvanized After Fabrication: Uncoated thickness of steel sheet hot-dip galvanized after fabrication:

a. 0.0747 inch (14 gage).

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AA Wire Products Co.
2. Dur-O-Wal, Inc.
3. Heckman Building Products, Inc.
4. Hohmann & Barnard, Inc.
5. Masonry Reinforcing Corp. of America.
6. National Wire Products Industries.
7. Southern Construction Products, Inc.

2.5 ADJUSTABLE MASONRY VENEER ANCHORS

A. General: Provide two-piece assemblies allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it; for attachment over sheathing to metal studs.

B. Screw-Attached Masonry Veneer Anchors: Units consisting of wire tie section and metal anchor section complying with the following requirements:

1. Veneer Anchors: Zinc alloy barrel, flanged head, and eye with interchangeable corrosion resistant self drilling threaded screws appropriate for permanent attachment in steel studs, and/or masonry back-up. Barrel shaft in lengths consistent with thickness of materials penetrated, allowing shoulder to seat directly on structural back-up and flanged head to cover fastener hole. 3/4 inch rubber washer under flanged head shall seal surface penetration of anchor.

2. Rectangular Ties: Hot dipped galvanized, 0.1875 inch pregalvanized wire diameter, conforming to ASTM A 82 with 1.30 oz/sf zinc coating conforming to Class B-3 of ASTM A153. Tie length shall provide not less than 2 inch embedment in mortar joints.

3. Products: Subject to compliance with requirements, provide the following:

a. Screw-Attached Brick Ties to Stud Walls:

AA401CE Screw on Anchor
AA400 Flex-o-Lok Flexible Tie

2.6 POSTINSTALLED ANCHORS

A. Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

1. Type: Chemical anchors.
2. Type: Expansion anchors.
3. Corrosion Protection: Carbon steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
4. Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 alloy 304 or 316 for bolts and nuts; alloy 304 or 316 for

anchor.
5. For cast-in-place and postinstalled anchors in concrete: Capability to sustain, without failure, a load equal to 4 times loads imposed by masonry.
6. For postinstalled anchors in grouted concrete masonry units: Capability to sustain, without failure, a load equal to 6 times loads imposed by masonry.

2.7 EMBEDDED FLASHING MATERIALS

A. Provide concealed flashings, shown to be built into masonry.

B. Provide concealed flashings as follows:

1. Fabricate through-wall flashings with deformations in both directions for integral mechanical mortar bond.

C. Reinforced Plastic Flashing: Manufacturer's standard composite plastic flashing as described below:

1. Polyester film bonded to 20 by 10 fiberglass scrim reinforcement and 1.25-mil black vinyl ethylene film, with a total thickness of 8 mils.
2. Joint Tape: Reinforced plastic flashing manufacturer's standard polyester tape, 2 inches wide by 2.0 mil thick.
3. Application: Use where flashing is fully concealed in masonry.

D. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.

E. Products: Subject to compliance with requirements, provide one of the following:

1. Reinforced Plastic Flashing:

a. "Fiberweb 200," Fiberweb International Corp.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Cell Vents: Provide the following:

1. Provide standard size cell vents equal to Mortar Maze vents at min. 2’-0” o.c. per mfg. recommendations.

2.9 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.

2.10 MORTAR AND GROUT MIXES

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification for job-mixed mortar and ASTM C 1142 for ready-mixed mortar, of types indicated below:

1. For masonry below grade and in contact with earth, and where indicated, use type indicated below:

a. Type M.

2. For reinforced masonry and where indicated, use type indicated below:

a. Type S.

3. For exterior, above-grade loadbearing and nonloadbearing walls and parapet walls; for interior loadbearing walls; for interior nonloadbearing partitions, and for other applications where another type is not indicated, use type indicated below:

a. Type S.

D. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.

E. Colored Aggregate Mortar: Produce mortar of color required by use of colored aggregates in combination with selected cementitious materials.

1. Mix to match Engineer's sample.

F. Grout for Unit Masonry: Comply with ASTM C 476 and referenced unit masonry standard.

2.11 SOURCE QUALITY CONTROL

A. Brick Tests: For each type and grade of brick indicated, units will be tested by qualified independent testing laboratory per ASTM C 67 except 5 bricks will be selected at

random for each 100,000 units or fraction thereof installed.

B. Concrete Masonry Unit Tests: For each type, class, and grade of concrete masonry unit indicated, units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.

B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use

full-size units without cutting where possible.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry with existing masonry.

3.3 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of referenced unit masonry standard.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less that nominal 4-inch horizontal face dimensions at corners or jambs.

1. Face Brick: Running Bond.

D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

F. Built-In Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

3.5 CAVITIES/AIR SPACES

A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

B. Tie exterior wythe to backup with continuous horizontal joint reinforcing.

C. Install vents in vertical head joints at the top of each continuous cavity/air space. Space vents and close off cavities/air spaces vertically and horizontally with blocking in manner indicated.

3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 MOVEMENT (CONTROL AND EXPANSION) JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control joint gaskets designed to fit standard sash block.

C. Form expansion joints in brick made from clay or shale as follows:

1. Form open joint of width indicated but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealers." Maintain joint free and clear of mortar.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING/Cell Vents

A. General: Install embedded flashing and cell vents in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

C. Install flashings as follows:

1. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches, and through the inner wythe to within 1/2 inches of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.
2. At heads and sills, extend flashing as specified above unless otherwise indicated but turn up ends not less than 2 inches to form a pan.
3. Install flashing in masonry veneer walls as specified above but carry flashing up face of sheathing at least 8 inches and behind air infiltration barrier/building paper.
4. Cut off flashing flush with face of wall after masonry wall construction is completed.

D. Install cell vents in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:

1. Form weep holes with product specified in Part 2 of this Section.
2. Form weep holes by keeping head joints free and clear of mortar.
3. Space weep holes 24 inches o.c.

E. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean brick by means of bucket and brush hand-cleaning method described in BIA "Technical Note No. 20 Revised" using the following masonry cleaner:

    a. Job-mixed detergent solution.

6. Clean limestone units to comply with recommendations in "ILI Handbook" of Indiana Limestone Institute of America, Inc.

D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure

unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION 04200

SECTION 06100 - ROUGH CARPENTRY

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 includes the following:

1. Wood grounds, nailers, and blocking.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 6 Section "Finish Carpentry".

1.3 DEFINITIONS

A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for the following products:

C. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:

1. For fire-retardant-treated wood products include certification by treating plant that treated material complies with specified standard and other requirements.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or

wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 DIMENSION LUMBER

A. For light framing (2 to 4 inches thick, 2 to 4 inches wide) provide the following grade and species:

1. "Standard" grade.
2. Any species graded under WWPA or WCLIB rules.

2.3 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power Driven Fasteners: National Evaluation Report NER-272.

D. Wood Screws: ANSI B18.6.1.

E. Lag Bolts: ANSI B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.

2.8 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.

B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates installed over concrete slabs directly in contact with earth.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

E. Countersink nail heads on exposed carpentry work and fill holes.

F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. 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; predrill as required.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding 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.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

END OF SECTION 06100

SECTION 08114 - CUSTOM STEEL DOORS AND FRAMES

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 includes custom-fabricated, commercial-quality steel doors and frames for doors and related openings.

B. Customized hollow metal work for other than doors, panels, and frames are specified in a Division 5 Section.

C. Building in of anchors and grouting of frames in masonry construction are specified in a Division 4 Section.

D. Door hardware installation is specified in Division 8 Section "Door Hardware" or "Finish Hardware."

E. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 8 Section "Door Hardware" for door hardware installed in doors and frames.
2. Division 8 Section "Flush Wood Door" for solid-core wood doors installed in steel frames.
3. Division 9 Section "Painting" for field painting of doors and frames.

F. Products furnished but not installed under this Section include steel doors and frames.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.

1. Manufacturer's certificate stating that each assembly required to be fire rated but exceeding sizes of tested assemblies has been constructed to conform to design,

materials, and details of construction equivalent to requirements for labeled units.

C. Shop Drawings: For fabrication and installation of custom steel doors and frames 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.

1.4 QUALITY ASSURANCE

A. Provide custom steel doors and frames manufactured by a single firm specializing in the production of this type of work, unless otherwise acceptable to the Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and job storage.

B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the Engineer; otherwise remove and replace damaged items as directed.

C. Store doors and frames at the building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid the use of nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Custom Steel Doors and Frames:

Curries
Mesker
Steel Craft Manufacturing Co.

2.2 MATERIALS

A. Cold-Rolled Steel Sheets: Commercial-quality, level, carbon steel, complying with ASTM A 366.

B. Hot-Rolled Steel Sheets and Strips: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569, free of scale, pitting, or surface defects.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526 and ASTM A 525 with A60 or G60 coating designation, 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.

2.3 DOORS

A. General: Provide flush design doors, 1-3/4 inches thick, seamless hollow construction, unless otherwise indicated.

1. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches. For double-acting swing doors, round vertical edges with 2-1/8-inch radius.
2. Unless otherwise required for acoustical or thermal doors, provide filler of fiberboard, mineral-wool board, or other insulating material solidly packed full door height to fill voids between inner core reinforcing members.
3. Reinforce doors with rigid tubular frame where stiles and rails are less than 8 inches wide. Form tubular frame with 16-gage steel, welded to outer sheets.

B. Painted Exterior Doors: Fabricate exterior doors of 2 outer, galvanized, 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. Provide thermal insulation. Provide weep-hole openings in the bottom of doors to permit escape of entrapped moisture.

1. Reinforce inside of doors with vertical galvanized sheet

steel sections not less than 22 gage. Space vertical reinforcing 6 inches o.c. and extend full door height. Spot weld at not more than 5 inches 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 inches o.c. vertically and horizontally over entire surface of both sides.

2. Reinforce tops and bottoms of doors with 16-gage horizontal steel channels welded continuously to outer sheets. Close top and bottom edges to provide flush, waterproof weather seal, as integral part of door construction or by addition of inverted steel channels.

C. Painted Interior Doors: Fabricate interior doors of 2 outer, cold-rolled, stretcher-leveled steel sheets not less than 18 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.

1. Reinforce inside of doors with vertical, hot-rolled, not less than 22-gage steel sections. Space vertical reinforcing 6 inches o.c. and extend full door height. Spot weld at not more than 5 inches 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 inches o.c. vertically and horizontally over entire surface of both sides.

2. Reinforce tops and bottoms of doors with 18-gage, horizontal steel channels, welded continuously to outer sheets.

D. Finish Hardware Reinforcement: Minimum gages of steel reinforcing plates for the following hardware:

1. Hinges and Pivots: 7 gage thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds. Note: Verify exterior doors with continuous hinge
2. Lock Face, Flush Bolts, Closers, and Concealed Holders: 12 gage.
3. All Other Surface-Mounted Hardware: 16 gage.

2.4 FRAMES

A. Fabricate frames of full-welded unit construction, with corners mitered, reinforced, continuously welded full depth

and width of frame. Knock-down type frames are not acceptable.

1. Form frames of minimum 14-gage galvanized steel sheets for exterior, and either cold or hot-rolled sheet steel of the following minimum gages for interior:

   a. Openings up to and including 4'-0" wide: 16 gage.
   b. Openings over 4'-0" wide: 14 gage.

B. Finish Hardware Reinforcement: Minimum gages of steel reinforcing plates for the following hardware:

1. Hinges and Pivots: 7 gage thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds. Note: Verify door frames for doors with continuous hinges
2. Strikes, Flush Bolts, and Closers: 12 gage.
3. Surface-Mounted Hold-Open Arms and Panic Devices: 12 gage.

C. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at top for grouting.

D. 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 inches wide by 10 inches long. Furnish at least 3 anchors per jamb up to 7'-6" height; 4 anchors up to 8'-0" jamb height; one additional anchor for each 24 inches 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 4 anchors for each jamb for frames up to 7'-6" in height; 5 anchors up to 8'-0" jamb height; one additional anchor each 24 inches or fraction thereof over 8'-0" height.
3. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8-inch concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches o.c., unless otherwise shown. Reinforce frames at anchor locations. Except for fire-rated openings, apply removable stop to cover anchor bolts unless otherwise indicated.

E. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of not less than 14-gage galvanized steel sheet, as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with 2 holes to receive fasteners, welded to bottom of jambs

and mullions.

F. Head Anchors: Provide 2 anchors at head of frames exceeding 42 inches wide for frames mounted in steel stud walls.

G. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations that are to be built into frame.

H. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

I. Rubber Door Silencers: Except on weatherstripped doors, drill stop in strike jamb to receive 3 silencers on single-door frames and drill head jamb stop to receive 4 silencers on double-door frames. Install plastic plugs to keep holes clear during construction.

2.5 STOPS AND MOLDINGS

A. Provide removable stops and moldings where indicated or required, formed of not less than 20-gage steel sheets matching steel of frames. Secure with countersunk flat or oval head machine screws spaced uniformly not more than 12 inches o.c. **Form corners with butted hairline joints.**

B. Coordinate width of rabbet between fixed and removable stops with type of glass and type of installation indicated.

2.6 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, fill, dress, and make smooth, flush, and invisible.

1. Interior Doors: Minimum 18-gage face sheets.
2. Exterior Doors: Minimum 16-gage face sheets.

B. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

C. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors **and frames** that have been fabricated as thermal insulating assemblies and tested in accordance with ASTM C 236 or C 976.

1. Unless otherwise indicated, provide assemblies U-value rating of 0.68 to .19 Btu/(hr by sq ft by deg F).

D. Finish Hardware Preparation: As follows:

1. Prepare doors and frames to receive finish hardware, including cutouts, reinforcing, mortising, 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 doors and frames 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 for Custom Steel Doors and Frames," published by Door and Hardware Institute.

E. Shop Painting: Clean, treat, and paint exposed surfaces of steel doors and frames, including galvanized surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
2. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT2), hot phosphate solution (SSPC-PT4), or basic zinc chromate-vinyl butyryl solution (SSPC-PT3).
3. Apply shop coat of 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 0.7 mils.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Frames: Provide custom steel frames for doors, transoms, side lights, borrowed lights, and other openings, of size and profile as indicated.

1. Install frames and accessories in accordance with shop drawings, manufacturer's data, and as herein specified.
2. Setting Masonry Anchorage Devices: Provide masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.
   a. 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.
4. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   a. At in-place concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices.
   b. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.
   c. Make field splices in frames as detailed on final shop drawings, welded and finished to match factory work.
   d. Remove spreader bars only after frames or bucks have been properly set and secured.

B. Door: Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

1. Jambs and Head: **3/32 inch.**
2. Meeting Edges, Pairs of Doors: **1/8 inch.**
3. Bottom: 3/8 inch, where no threshold or carpet.
4. Bottom: 1/8 inch, at threshold or carpet.

C. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

A. Final Adjustments: Check and readjust operating hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that 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 08114

SECTION 08211 - FLUSH WOOD DOORS

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 work of this section.

1.2 SUMMARY:

A. Extent and location of each type of flush wood door is indicated on drawings and in schedules.

B. Types of doors required include the following:

1. Solid core flush wood doors with wood veneer faces.

C. Factory-prefitting to frames and factory-premachining for hardware for wood doors is included in this section.

D. Metal door frames for flush wood doors are specified in another Division-8 section.

1.3 SUBMITTALS:

A. Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

1. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.

1.4 QUALITY ASSURANCE:

A. Quality Standards: Comply with the following standards:

1. NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors", of National Wood Window and Door

Association (NWWDA).

2. AWI Quality Standard: "Architectural Woodwork Quality Standards"; including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDA quality standard.

C. Manufacturer: Obtain doors from a single manufacturer.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.

B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable or concealed markings.

1.6 PROJECT CONDITIONS:

A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:

1. Referenced AWI quality standard including Section 100-S-3 "Moisture Content".

1.7 WARRANTY:

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Door Manufacturer's Warranty: Submit written agreement in door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.

1. Warranty shall also include reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
2. Warranty shall be in effect during following period of time after date of Substantial Completion.
3. Solid Core Interior Doors:

    a. Two years.

C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Solid Core Doors with Wood Veneer Faces:

    a. Algoma Hardwoods, Inc.
    b. Chappell Door Company.
    c. VT Industries
    d. Graham Manufacturing Corp.
    e. Mohawk.

2.2 INTERIOR FLUSH WOOD DOORS:

A. Solid Core Doors for Transparent Finish: Comply with the following requirements:

1. Faces: Red Oak, plain sliced, factory finished.
2. AWI Grade: Premium.
3. Construction: PC-7 (Particleboard core - 7-ply)

2.4 FABRICATION:

A. Fabricate flush wood doors to produce doors complying with following requirements:

1. In sizes indicated for job-site fitting. (Contractors Option)
2. Factory-prefit and premachine doors (Contractors Option) to fit frame opening sizes indicated with the following uniform clearances and bevels:

    a. Comply with tolerance requirements of AWI for

prefitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.

b. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.

B. Metal Astragals: Premachine astragals and formed steel edges for hardware where required for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine installed door frames prior to hanging door:

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
2. Reject doors with defects.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Hardware: For installation see Division-8 "Finish Hardware" section of these specifications.

B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and of referenced AWI standard and as indicated.

C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Fitting Clearances for Non-Rated Doors: Provide **1/8"** at jambs and heads; **1/16"** per leaf at meeting stiles for pairs of doors; and **1/8"** from bottom of door to top of decorative floor finish or covering. Where threshold is

shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.

2. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.

D. Prefit Doors: Fit to frames for uniform clearance at each edge.

3.3 ADJUSTING AND PROTECTION:

A. Operation: Rehang or replace doors which do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 08211

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Door hardware for doors specified in "Hardware Sets" and required by actual conditions. Include screws, bolts, expansion shields, electrified door hardware, and other devices for proper application of hardware.

1.2 REFERENCES

A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):
1. ANSI/BHMA A156.1 Butts & Hinges (2006).
2. ANSI/BHMA A156.2 Bored & Preassembled Locks & Latches (2011).
3. ANSI/BHMA A156.4 Door Controls - Closers (2008).
4. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2010).
5. ANSI/BHMA A156.6 Architectural Door Trim (2010).
6. ANSI/BHMA A156.7 Template Hinge Dimensions (2009).
7. ANSI/BHMA A156.18 Materials & Finishes (2006).
8. ANSI/BHMA A156.21 Thresholds (2009).
9. ANSI/BHMA A156.22 Door Gasketing Systems (2012).
10. ANSI/BHMA A156.28 Keying Systems (2007).
11. ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames (2006).
12. ANSI/BHMA A156.115W Hardware Preparation in Wood Doors with Wood or Steel Frames (2006).
13. ANSI/BHMA A250.13 Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies (2003).

B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities
2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

C. Underwriters Laboratories, Inc. (UL):
1. UL 1784 Air Leakage Test of Door Assemblies.
2. UL/ULC Listed.

D. Door and Hardware Institute (DHI):
1. DHI Publication - Keying Systems and Nomenclature (1989).
2. DHI Publication - Abbreviations and Symbols.
3. DHI Publication - Installation Guide for Doors and Hardware.
4. DHI Publication - Sequence and Format of Hardware Schedule (1996).

E. Building Codes
1. IBC Indiana Building Code.

1.3 SUBMITTALS

A. Submit in accordance with Conditions of the Contract and provisions of Section 01 30 00 - Administrative Requirements.

B. Shop Drawings: Hardware schedule shall be organized in vertical format illustrated in DHI Publications Sequence and Formatting for the Hardware Schedule. Include abbreviations and symbols page according to DHI Publications Abbreviations and Symbols. Complete nomenclature of items required for each door

opening as indicated
1. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of hardware.

C. Submit manufacturer's catalog sheet on design, grade and function of items listed in hardware schedule. Identify specific hardware item per sheet, provide index, and cover sheet.

D. Coordination: Distribute door hardware templates to related divisions within fourteen days of receiving approved door hardware submittals.

1.4 QUALITY ASSURANCE

A. Door hardware shall conform to ICC/ANSI A117.1. Handles, Pulls, Latches, Locks and operating devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.

B. Door hardware shall be certified to ANSI/BHMA standards as noted, participate and be listed in BHMA Certified Products Directory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide a clean, dry and secure room for hardware delivered to Project but not yet installed.

B. Furnish hardware with each unit marked and numbered in accordance with approved finish hardware schedule. Include door and item number for each type of hardware.

C. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

A. General Warranty: Owner may have under provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by Contractor under requirements of the Contract documents.

B. Special Warranty: Warranties specified in this article shall not deprive Owner of other rights. Contractor, hardware supplier, and hardware installer shall be responsible for servicing hardware and keying related problems.
1. Ten years for manual door closers.
2. Five years for mortise, auxiliary and bored locks.
3. Five years for exit devices.

C. Products judged defective during warranty period shall be replaced or repaired in accordance with manufacturer's warranty at no cost to Owner. There is no warranty against defects due to improper installation, abuse and failure to exercise normal maintenance.

PART 2 PRODUCTS

2.1 HINGES

A. Hinges, including electric hinges and self-closing hinges when scheduled, shall be of one manufacturer as listed for continuity of design and consideration of warranty and shall be certified and listed by the following:
   1. Butts and Hinges: ANSI/BHMA A156.1
   2. Template Hinge Dimensions: ANSI/BHMA A156.7

B. Butt Hinges:
   1. Hinge weight and size unless otherwise indicated in hardware sets:
      a. Doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of .134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.
   2. Base material unless otherwise indicated in hardware sets:
      a. Exterior Doors: 304 Stainless Steel, Brass or Bronze material.
      b. Interior Doors: Steel material.
      c. Stainless Steel ball bearing hinges shall have stainless steel ball bearings. Steel ball bearings are unacceptable.
   3. Quantity of hinges per door unless otherwise stated in hardware sets:
      a. Doors 60 inches (1524 mm) up to 90 inches (2286 mm) in height provide 3 hinges.
   4. Hinge design and options unless otherwise indicated in hardware sets:
      a. Hinges are to be of a square corner five-knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
      b. Out-swinging exterior and out-swinging access-controlled doors shall have non-removable pins (NRP) to prevent removal of pin while door is in closed position.
      c. When shims are necessary to correct frame or door irregularities, provide metal shims only.

   5. Acceptable Manufacturer:
      a. Hager Companies
      b. Ives
      c. McKinney

2.2 LOCKS AND LATCHES

A. Locks and latches shall be of one manufacturer as listed for continuity of design and consideration of warranty. Product to be certified and listed by following:
   1. ANSI/BHMA A156.2 Series 4000 Certified to Grade 1.
   2. ANSI/BHMA A250.13 Certified for a minimum design load of 1150lbf (100psf) for single out swinging doors measuring 36 inches (914 mm) in width and 84 inches (2134 mm) in height and a minimum design load of 1150lbf (70psf) for out swinging single doors measuring 48 inches (1219 mm) in width and 84 inches (2134 mm) in height.
   3. ICC/ANSI A117.1.

B. Lock and latch function numbers and descriptions of manufacturer's series as listed in hardware sets. Material and Design:
   1. Lock and Latch chassis to be Zinc dichromate for corrosion resistance.
   2. Keyed functions to be of a freewheeling design to help resists against vandalism.
   3. Non-handed, field reversible.
   4. Thru-bolt mounting with no exposed screws.
   5. Levers shall be Zinc cast and plated to match finish designation in hardware sets.
   6. Roses shall be of solid Brass or Stainless-Steel material.

C. Latch and Strike:
   1. Stainless Steel latch bolt with minimum of 1/2 inch (13 mm) throw and deadlocking for keyed and exterior functions. Provide 3/4-inch (19 mm) latch bolt for pairs of fire rated doors where required by

door manufacture. Standard backset to be 2-3/4 inches (70 mm) and faceplate shall be adjustable to accommodate a square edge door or a standard 1/8 inch (3 mm) beveled edge door.
2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4 inches (32 mm) by 4-7/8 inches (124 mm) with proper lip length to protect surrounding trim.

D. Acceptable Manufacturer:
1. Schlage
2. No alternate manufacturers will be permitted without architect’s written approval prior to bidding.

2.3 CYLINDERS AND KEYING

A. Cylinders shall be of one manufacturer as listed for continuity of design and consideration of warranty.

B. Standards: Manufacturer shall meet the following:
1. Auxiliary Locks: ANSI/BHMA A156.5
2. DHI Handbook "Keying systems and nomenclature" (1989)

C. Cylinders:
1. Shall be furnished with cams/tailpieces as required for locking device that is being furnished for project.

D. Keying:
1. Key into Owner's existing keying system.
2. Keys to be shipped to Owner's representative, individually tag per keying conference.

E. Acceptable Manufacturer:
1. Schlage
2. No alternate manufacturers will be permitted without architect’s written approval prior to bidding.

2.4 CLOSERS

A. Shall be product of one manufacturer. Unless otherwise indicated on hardware schedule, comply with manufacturer's recommendation for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirements, and fire rating. Manufacturer to be certified and or listed by the following:
1. BHMA Certified ANSI A156.4 Grade 1.
2. ADA Compliant ANSI A117.1.

B. Material and Design:
1. Provide cast iron non-handed bodies with full plastic covers.
2. Closers shall have separate staked adjustable valve screws for latch speed, sweep speed, and backcheck.
3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
4. One-piece seamless steel spring tube sealed in hydraulic fluid.
5. Double heat-treated steel tempered springs.
6. Precision-machined heat-treated steel piston.
7. Triple heat-treated steel spindle.
8. Full rack and pinion operation.

C. Mounting:
1. Out swing doors shall have surface parallel arm mount closers except where noted on hardware schedule.
2. In swing doors shall have surface regular arm mount closers except where noted on hardware schedule.

D. Size closers in compliance with requirements for accessibility (ADDAG). Comply with following maximum

opening force requirements. Interior hinged openings: 5.0 lb (2.25 Kg) Fire rated and exterior openings shall have minimum opening force allowable by authority having jurisdiction.

E. Fasteners: Provide self-reaming and self-tapping wood and machine screws and sex nuts and bolts for each closer.

F. Acceptable Manufacturer:
1. LCN
2. No alternate manufacturers will be permitted without architect's written approval prior to bidding.

2.5 EXIT DEVICES

A. Shall be product of one manufacturer. Manufacturer to be certified and or listed by the following:
1. BHMA Certified ANSI A156.3 Grade 1.

B. Acceptable Manufacturer:
1. Von Duprin
2. No alternate manufacturers will be permitted without architect's written approval prior to bidding.

2.6 STOPS AND HOLDERS

A. Wall Stops: Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops when possible. Door stops and holders mounted in concrete floor or masonry walls shall have stainless steel machine screws and lead expansion shields. Manufacturer shall meet requirements for Auxiliary Hardware: ANSI/BHMA A156.16.

B. Acceptable Manufacturer:
1. Hager Companies
2. Ives.
3. Rockwood

2.7 DOOR GASKETING AND WEATHERSTRIP

A. Provide continuous weatherstrip gasketing on exterior doors. Provide non-corrosive fasteners for exterior applications.
1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
4. Drip Guard: Apply to exterior face of frame header. Lip length to extend 4 inches (102 mm) beyond width of door.

B. Standards: Manufacturer shall meet requirements for:
1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.
2. Shall be BHMA certified for door sweeps, automatic door bottoms, and adhesive applied gasketing.

C. Acceptable Manufacturer: Hager Companies, NGP, and Pemko
1. Perimeter Gasketing: Hager Companies: 726S adhesive applied, 881S stop applied.
2. Door Bottom Sweeps: Hager Companies: 759S.
3. Overhead Drip Guard: Hager Companies: 810S.

2.8 THRESHOLDS

A. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless-steel machine screws complying with requirements specified in Division 7 Section "Joint Sealants". Notched in field to fit frame by hardware installer. Refer to Drawings for special details. Manufacturer shall meet requirements for:
1. Thresholds: ANSI/BHMA A156.21.

2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

B. Acceptable Manufacturer:
1. Hager Companies
2. NGP
3. Pemko

2.9 SILENCERS

A. Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame and four per Dutch door frame. Manufacturer shall meet requirements for: Auxiliary Hardware: ANSI/BHMA A156.16.

B. Acceptable Manufacturer:
1. Hager Companies
2. Ives
3. Trimco

2.10 FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples.

B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install hardware per manufacturer's instructions and in compliance with the following as applicable:
1. NFPA 80; NFPA 105; ICC/ANSI A117.1; ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames; ANSI/BHMA A156.115W Hardware Preparation in Wood Doors with Wood or Steel Frames; DHI Publication - Installation Guide for Doors and Hardware; UL10C/UBC7-2; Local building code.
2. Approved shop drawings.
3. Approved finish hardware schedule.

B. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

3.5 ADJUSTMENT, CLEANING AND DEMONSTRATING

A. Adjustment: Adjust and check each opening to ensure proper operation of each item of finish hardware. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application at no cost to Owner.

C. Cleaning: Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no cost to Owner.

3.6 PROTECTION

A. Leave manufacturer's protective film intact and provide proper protection for all other finish hardware items that do not have protective material from the manufacture until Owner accepts Project as complete.

3.7 HARDWARE SET SCHEDULE

A.. Leave manufacturer's protective film intact and provide proper protection for all other finish hardware items that do not have protective material from the manufacture until Owner accepts Project as complete.

3.8 PROTECTION

A. Guide: Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, performance, exposure, and like characteristics of door hardware, and may not be complete. Provide door hardware required to make each set complete and operational.

B. Hardware schedule does not reflect handing, backset, method of fastening and like characteristics of door hardware and door operation.

C. Review door hardware sets with door types, frames, sizes and details on drawings. Verify suitability and adaptability of items specified in relation to details and surrounding conditions.

Hardware Sets

SET 01

6	EA	HINGES	BB1279 – 4.5 X 4.5 X NRP	652 HAGER
1	EA	EXIT DEVICE	9927L X LBR	626 VON DUPRIN
2	EA	CYLINDER	AS REQUIRED	626 SCHLAGE
2	EA	CLOSER	4040XP	689 LCN
2	EA	WALL STOP	409	630 ROCKWOOD
2	EA	KICKPLATE	10” X 1” LDW	630 ROCKWOOD

SET 02

3	EA	HINGES	BB1279 – 4.5 X 4.5 X NRP	652 HAGER
1	EA	EXIT DEVICE	99L-F	626 VON DUPRIN
1	EA	CYLINDER	AS REQUIRED	626 SCHLAGE
1	EA	CLOSER	4040XP	689 LCN
1	EA	WALL STOP	409	630 ROCKWOOD
1	EA	KICKPLATE	10” X 2” LDW	630 ROCKWOOD
1	SET	SEALS	5050C	BLK NGP

**ALLOW 180 DEGREE SWING.

SET 03

3	EA	HINGES	BB1279 – 4.5 X 4.5	652 HAGER
1	EA	STOREROOM	ND80PD X RHO	626 SCHLAGE
1	EA	CLOSER	4040XP	689 LCN
1	EA	WALL STOP	409	630 ROCKWOOD
1	EA	KICKPLATE	10” X 2” LDW	630 ROCKWOOD

SET 04

6	EA	HINGES	MATCH EXISTING PREP	652 HAGER
1	EA	EXIT DEVICE	9927L-F X LBR	626 VON DUPRIN
2	EA	CYLINDER	AS REQUIRED	626 SCHLAGE
2	EA	CLOSER	4040XP	689 LCN
2	EA	WALL STOP	409	630 ROCKWOOD
2	EA	KICKPLATE	10” X 1” LDW	630 ROCKWOOD
1	SET	SEALS	5050C	BLK NGP
1	SET	ASTRAGAL	115N	AL NGP

**PROVIDE NEW HINGES TO MATCH EXISTING FRAME PREP. FIELD VERIFY.

SET 05

3	EA	HINGES	BB1279 – 4.5 X 4.5	652 HAGER
1	EA	PASSAGE	ND10S X RHO	626 SCHLAGE
1	EA	WALL STOP	409	630 ROCKWOOD

SET 06

HARDWARE IS EXISTING TO BE RE-USED.

Door #	Set #
101A	1
101B	2
102	3
103	4
104	5
105	5
106	6

END OF SECTION

SECTION 08800 - GLASS AND GLAZING

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 work of this section.

1.2 DESCRIPTION OF WORK:

A. Definitions: "Glass" includes prime glass, processed glass, and fabricated glass products. "Glazing" includes glass installation and materials used to install glass. Types of work in this section include glass and glazing for:

1. Window Units
2. Entrance and Other Doors
3. Aluminum Entrances
4. Fixed and Side Lights

B. "Glass Products" is hereby defined to include glazing plastics.

1.3 QUALITY ASSURANCE:

A. Prime Glass Manufacturer: One of the following for each type/color/pattern of glass.

1. Ford Glass Company
2. Libbey-Owens-Ford Company
3. PPG Industries, Inc.

B. Safety Glass Standard: CPSC 16 CFR 1201.

1.4 SUBMITTALS:

A. Samples: 2 samples, 12" square, of each glass product, except for clear single-pane units.

PART 2- PRODUCTS

2.1 Materials

2.2 Glass Products:

A. Materials shall conform to the following requirements:
   1. "Glass, Plate, Sheet, Figured, Float, Flat for Glazing and Other Uses", FS-DD-G-451C.

B. Laminated safety glass shall be manufactured to comply with federal specification DD-G-451d, 1977 and ANSI Z97.1, 1975. Type 1/4" clear or tinted (Grey Standard Tint) DSD float laminated plastic thickness .030".

C. Tempered Glass shall be heat treated double strength, A Grade, float glass, 1/4" thickness clear or tinted (Bronze Standard Tint).

D. Wire glass shall be 1/4" thick clear rolled glass with .020" diameter wire welded into squares or rectangular pattern embedded in approximate center of sheet. Glass shall be polished both sides.

E. Spandral Glass: Grade A (Heat Strengthened), unless otherwise indicated; Style II (interior surface ceramic coated); Type I (float); Quality Q3 (Glazing select), and as follows:

   1. Color Bronze: Provide color as selected by Engineer from Manufacturer's standard colors.

   2. Insulated Backing: Factory laminate the following materials on back of each glass unit, with edge treatment as required for application indicated:

   3. Glass fiber insulation, 2-lb. per Cu. Ft. density, 1" thick, with 0.005" thick Foil-Scrim-Kraft vapor retarder backing.

F. 1" Insulating glass shall be total 1" thick composed of two sheets of 1/4" glass (Glass must meet State and National Codes) with 1/2" air space.

   1. Glass sheets shall be separated with metal spacers and sealed with a polyisobutylene sealant. Air space shall be at atmospheric pressure and space shall be kept dehydrated with a permanent drying agent in the air space.

   2. Outdoor sheet to be Bronze, indoor sheet shall be clear glass.

      a. Gray: Manufacturer's standard tint, with visible light transmittance of 16%, summer daytime U-value of 0.58, winter nighttime U-value of 0.49, shading coefficient of 0.38 and outdoor reflectance of 37%.

2.3 GLAZING SEALANTS AND COMPONENTS:

A. General: Provide color of exposed sealant/compound indicated or if not otherwise indicated, as selected by Engineer from manufacturer's standard colors, or black if no color is selected. Comply with manufacturer's recommendations for selection of hardness, depending upon the location of each application, conditions at time of installation, and performance requirements as indicated. Select materials, and variations or modifications, carefully for compatibility with surfaces contacted in the installation.

B. Part Polysulfide Glazing Sealant (2Ps-GS): Elastomeric polysulfide sealant complying with FS TT-S-227, Class A, Type 2; specially compounded and tested to show a minimum of 20 years resistance to deterioration in normal glazing applications.

2.4 GLAZING GASKETS:

A. Molded Neoprene Glazing Gaskets (MN-GG): Molded or extruded neoprene gaskets of the profile and hardness required for water tight construction; complying with ASTM D 2000 designation 2BC 415 to 3BC 620, black.

2.5 MISCELLANEOUS GLAZING MATERIALS:

A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer. Structural silicone w/silicone compatible tape backer.

B. Setting Blocks: Neoprene or EPDM, 70-90 durometer hardness, with proven compatibility with sealants used.

C. Spacers: Neoprene or EPDM, 40-50 durometer hardness and proven compatibility with sealants used.

PART 3 - EXECUTION

3.1 STANDARDS AND PERFORMANCE:

A. Watertight and airtight installation of each glass product is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.

C. Glazing channel dimensions as shown are intended to provide necessary bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

D. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of Flat Glass Marketing Association "Glazing Manual", except where more stringent requirements are indicated.

3.2 PREPARATION FOR GLAZING:

A. Clean glazing channel and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

B. Apply primer or sealant to joint surfaces where recommended by sealant manufacturer.

3.3 GLAZING:

A. Install setting blocks of proper size in sill rabbet, located 1/4th of glass width from each corner. Set blocks in thin course of heel-bead compound, if any.

B. Provide spacers inside and out, of proper size and spacing, for glass sizes larger than 50 united inches, except where gaskets or preshimmed tapes are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.

D. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in

channel at heel of jambs and head (do not leave voids in sill channels), except as otherwise indicated and depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.

E. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

F. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

G. Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and eliminate stains and discolorations.

H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel bead.

I. Gasket Glazing: Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

J. Tape Glazing:
1. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

2. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

3. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

5. Do not remove release paper from tape until just before each lite is installed.

6. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.4 CURE, PROTECTION AND CLEANING:

A. Protect exterior glass from breakage immediately upon installation, by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean surfaces. Cure sealants for high early strength and durability.

B. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

C. Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Comply with glass product manufacturer's recommendations for final cleaning.

END OF SECTION 08800

SECTION 09250 - GYPSUM DRYWALL

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

SUMMARY:

This section includes the following:

- Exterior framing members to receive Gypsum Base.
- Interior framing members to receive Gypsum Base.
- Gypsum Drywall applied to metal support system.
- Gypsum Drywall applied to furring.
- Gypsum Board bonded adhesively to interior masonry substrates.
- Gypsum Sheathing applied to exterior metal support system.
- Drywall finishing (joint tape and compound treatment).
- Air-infiltration barrier.

Related Sections: The following sections contain requirements that relate to this Section:

- Division 7 Section "Building Insulation".

QUALITY ASSURANCE:

Fire-Resistance Ratings: Where gypsum drywall systems with fire-resistance ratings are indicated, provide materials and installations which are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

Gypsum Board Terminology Standard: GA-505 by Gypsum Association.

Single-Source Responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

DELIVERY, STORAGE AND HANDLING:

Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

Handle gypsum boards to prevent damage to edges, ends and surfaces.

Protect metal corner beads and trim from being bent or damaged.

PROJECT CONDITIONS:

Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.

Cold Weather Protection: When ambient outdoor temperatures are below 55 deg. F (13 deg. C) maintain continuous, uniform, comfortable building working temperatures of not less than 55 deg. F (13 deg. C) for a minimum period of 48 hours prior to, during and following application of gypsum board and joint treatment materials or bonding of adhesives.

Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Manufacturer: Subject to compliance with requirements provide products of one of the following:

Metal Support Materials:

Dale Industries, Inc.
Dietrich Industries, Inc.
Gold Bond Building Products Div., National Gypsum Co.
Milcor Division; Inryco, Inc.
United States Gypsum Co.

Direct Suspension Systems:

Chicago Metallic Corp.
Donn Corporation
United States Gypsum Co.

Gypsum Board and Related Products:

American Gypsum Co.
Gold Bond Building Products Div., National Gypsum Co.
United States Gypsum Co.

STEEL FRAMING COMPONENTS:

General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.

Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

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.

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:

1. Thickness: 0.0329 inch, unless otherwise indicated or as approved by Mfr.

2. Depth: 1-5/8", unless otherwise indicated.

Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 7/8 inch.

STEEL FRAMING FOR WALLS (Exterior)

Steel Studs and Runners: 18-gage units, Depth 6", fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.

Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

Finish of installation accessories to match that of main framing components, unless otherwise indicated.

Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

STEEL FRAMING FOR WALLS AND PARTITIONS (Interior)

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 or as approved by Mfr.

2. Depth: 1 5/8”, 3-5/8" and 6", where indicated.

Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:

1. Depth: 7/8 inch.

GYPSUM BOARD:

Gypsum Wallboard: ASTM C 36, of types, edge configuration and thickness indicated below; in maximum lengths available to minimize end-to-end butt joints.

Type: Regular, unless otherwise indicated.
Type: Type X for fire-resistant rated assemblies and where indicated.
Type: Moisture resistant at all restrooms.
Edges: Tapered.
Thickness: 5/8"

Gypsum Sheathing Board: Water-resistant core, sheathing board consisting of noncombustible gypsum core incorporating a water-resistant material, surfaced on face, back and along edges with water-repellent paper; complying with ASTM C79 and requirements indicated below:

Type: Regular (not Type X)
Edge and End Configuration: V-shaped tongue and groove long edges, square ends.
Thickness: 5/8 inch. See details
Fasteners: Type S steel drill screws, 1 inch long, with

organic-polymer coating or other corrosion-protective coating having a salt-spray resistance of more than 800 hours per ASTM B117.

TRIM ACCESSORIES:

General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, and one-piece control joint beads.

JOINT TREATMENT MATERIALS:

General: Type recommended by the manufacturer for the application indicated, except as otherwise indicated.

Joint Tape: Paper reinforcing tape.

Joint Compound: On interior work provide chemical-hardening-type for bedding and filling, ready-mixed vinyl-type or vinyl-type powder type for topping.

Water-Resistant Joint Compound: Special water-resistant type for treatment of joints, fastener heads and cut edges of water-resistant board.

Air-Infiltration Barrier: Provide the following product:

Polyethylene sheet, 0.0061 inch thick, formed by spinning continuous strands of fine, high-density polyethylene interconnected fibers and bonding them together by heat and pressure; incorporating an additive to provide ultra-light resistance for up to 120 days; with a water-vapor transmission rate equaling 669 grams in 24 hours through 1 sq. meter of surface per ASTM E 96 procedure B and flame-spread and smoke-developed ratings of 0 and 25, respectively, per ASTM E 84. Dupont Tyvek or equal.

MISCELLANEOUS MATERIALS:

General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.

Gypsum Board Screws: Comply with ASTM C 646.

Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant.

PART 3 - EXECUTION

INSTALLATION OF STEEL FRAMING, GENERAL:

Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 844 requirements that apply to framing installation.

Install supplementary framing, blocking and bracing at terminations in the veneer plaster construction 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 veneer plaster manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

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 to attain lateral support and avoid axial loading.

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.

INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS:

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.
2. Do not attach hangers to metal roof deck.

Do not connect or suspend steel framing from ducts, pipes or conduit.

Keep hangers and braces 2 inches clear of ducts, pipes and conduits.

Sway-brace suspended steel framing with hangers used for support.

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.

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.

Wire-tie or clip furring members to main runners and to other structural supports as indicated.

INSTALLATION OF STEEL FRAMING FOR WALLS (Exterior):

General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.

Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls, or warped surfaces and similar requirements.

Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.

Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c. Weld at each intersection.

Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.

1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

Field Painting: Touch-up damaged shop-applied protective coatings. Use compatible primer for prime-coated surfaces; use galvanizing repair system for galvanized surfaces.

INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS (Interior):

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.

Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from plane of faces of adjacent framing.

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 base.

Terminate partition framing at suspended ceilings where indicated.

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 construction: 16 inches on center.

Install steel studs so that flanges point in the same direction and gypsum base can be installed in the direction opposite to that of the flange.

Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of veneer plaster 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.

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.

Space wall furring members 16" o.c. unless otherwise indicated.

GYPSUM SHEATHING INSTALLATION REQUIREMENTS:

General: Install gypsum sheathing to comply with manufacturer's instructions, GA-253, and the following:

Cut boards at penetrations, edges and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8 inch setback where non-load-bearing construction abuts structural elements.

Coordinate sheathing installation with flashing and joint sealant installation so that these combined materials are installed in the sequence and manner that prevents exterior moisture from passing through completed exterior wall assembly.

Apply fasteners so that screw heads bear tightly against face of gypsum sheathing boards but do not cut into face paper.

Do not bridge expansion joints with gypsum sheathing,; cut and space edges to match spacing of structural support elements.

Vertical Installation: Install 4-foot-wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those adjoining boards. Screw-attach boards at perimeter and within field of board to each steel stud as follows:

Fasteners spaced approximately 8 inches o.c. and set back 3/8 inch minimum from edges and ends of boards.

Air-Infiltration Barrier Application: Cover gypsum board sheathing with air-infiltration barrier as follows:

Install in accordance with Manufacturer's instruction over exterior sheathing. Seal joints and penetrations through

weather resistant barrier with specified tape and fasteners. Air infiltration barrier shall be air-tight and free from holes, tears, and punctures. All window and door penetrations are to be taped per manufacturer instructions.

GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS:

Gypsum Board Application and Finishing to be in accordance with the manufacturer's standards.

Install sound attenuation blankets in all interior metal stud walls, prior to gypsum board.

Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 1'0" in alternate courses of board.

Install wall/partition boards vertically to avoid end-butt joints wherever possible.

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" open space between boards. Do not force into place.

Locate either edge or end joints over supports, except in horizontal applications or 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.

Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

METHODS OF GYPSUM DRYWALL APPLICATION:

Single-layer Application: Install gypsum wallboard.

On partitions/walls apply gypsum board vertically, unless otherwise indicated, and provide sheet lengths which will minimize end joints.

Double-Layer Application: Install gypsum backing board for base layers and gypsum wallboard for face layers.

On partitions/walls apply base layers and face layers vertically (parallel to framing) with joints of base layers located over stud and face layer joints offset at least one stud member with base layer joints. Stagger joints on opposite sides of partitions.
Fastening Methods: Apply gypsum boards to supports as follows:

Fasten with screws.

Direct Bonding to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members or base layer of gypsum board) comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.

INSTALLATION OF DRYWALL TRIM ACCESSORIES:

General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports.

Install metal corner beads at external corners of drywall work.

Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound. Install L-type trim where work is tightly abutted to other work. Install L-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

FINISHING OF DRYWALL:

General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, if any, using type of compound recommended by manufacturer.

Level of Finish
All gypsum board scheduled to receive paint or wall covering to receive Level 4 Finish.

Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.

Apply joint compound in 3 coats (not including prefill of openings in base), and sand between last 2 coats and after last coat.

Refer to sections on painting, coatings and wall-coverings in Division-9 for decorative finishes to be applied to drywall work.

PROTECTION OF WORK:

Provide final protection and maintain conditions in a manner suitable to Installer, which ensures gypsum drywall work being without damage or deterioration at time of substantial completion.

END OF SECTION - 09250

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

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 includes acoustical panel ceilings installed with exposed suspension systems.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 15 Section "Air Outlets and Inlets" for Grilles, Registers, and Diffusers in acoustical ceilings.

2. Division 16 Section "Interior Lighting Fixtures" for lighting fixtures in acoustical ceilings.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of product specified.

2. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual acoustical units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.

3. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6-inch-square samples of each acoustical panel type, pattern, and color.
b. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

B. Fire-Performance Characteristics: Provide acoustical ceilings that are identical to those tested for the following fire-performance characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.

a. Flame Spread: 25 or less.
b. Smoke Developed: 50 or less.

C. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1. Obtain suspension system from same manufacturer that produces acoustical ceiling units.

E. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully

enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.7 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the following:

2. Type "A"

Mineral Base Panels - Water Felted, with Painted Finish and Perforated and Fissured Pattern, Non-Fire-Resistance Rated:

Surface Finish: Factory-applied vinyl latex paint.
Color: White
Light Reflectance: LR1(min. 75)
Fed. Spec. SS-S-188B and ASTM E 1264.
Size: 24" x 24" x 5/8"
Edge Detail: Angled Tegular Lay-In

NRC Range: .50-.60
CSTC Range: 35-39
Surface Burning Characteristics: Class A per ASTM E 1264 and Fed. Spec. SS-S-118B Flame Spread 25 or under; UL Labeled.

a. "Minaboard Cortega 704," Armstrong World Industries Inc. or approved equal.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Non-Fire-Resistance-Rated Steel Suspension Systems:

Material: Double-web electrogalvanized steel
Face Dimension: 15/16"
Profile: Exposed Tee
Color: White
Surface Finish: Baked polyester paint.

a. Armstrong World Industries, Inc.
b. Chicago Metallic Corporation.
c. National Rolling Mills, Inc.
d. USG Interiors, Inc.

2. Edge Moldings:

a. Armstrong World Industries, Inc.
b. Chicago Metallic Corporation.
c. Fry Reglet Corp.
d. National Rolling Mills, Inc.
e. USG Interiors, Inc.

2.2 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

1. Gage: Provide wire sized so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct-Hung), will be less than yield stress of wire, but provide not less than 0.106-inch diameter (12 gage).

E. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated.

1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.3 MISCELLANEOUS MATERIALS

A. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

B. Arrange acoustical units and orient directionally patterned units in a manner shown by reflected ceiling plans.

C. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that

are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
5. Do not attach hangers to steel deck tabs.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member. Install additional hangers at all four corners of light fixtures.

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D. Install edge moldings at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical units.

1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
2. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

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 borders

and at penetrations.

3.4 CLEANING

A. Clean exposed surfaces of acoustical 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 that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09900 - PAINTING

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 includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Engineer will select from standard colors or finishes available.

C. Painting of exposed bare and covered pipes and conduits (including color coding) installed by the Mechanical Contractor is by the Mechanical Contractor.

D. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

E. Related Sections: The following sections contain requirements that relate to this section:

1. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
2. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
3. Divisions 15 and 16: Painting mechanical and electrical work is specified in Divisions 15 and 16, respectively.

1.3 DEFINITIONS

A. "Paint" includes coating systems materials, primers,

emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.4 SUBMITTALS

A. Product Data: Manufacturer's technical information, label analysis, and application instructions for each material proposed for use.

1. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

B. Samples for initial color selection in the form of manufacturer's color charts.

1. After color selection, the Engineer will furnish color chips for surfaces to be coated.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Engineer of problems anticipated using the materials specified.

C. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equal products of other manufacturers.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1. Product name or title of material.

2. Product description (generic classification or binder type).
3. Federal Specification number, if applicable.
4. Manufacturer's stock number and date of manufacture.
5. Contents by volume, for pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).

C. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. PPG Industries, Pittsburgh Paints (Pittsburgh).
2. Pratt and Lambert (P & L).
3. The Sherwin-Williams Company (S-W).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime. Notify Engineer in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.

2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

3. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures

Painting Council.

a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

C. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

C. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

1. Paint colors, surface treatments, and finishes are indicated in "schedules."
2. Provide finish coats that are compatible with primers used.
3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat

surfaces.

5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

F. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

G. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

H. Pigmented (Opaque) Finishes: 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.

I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide egg shell finish for final coats.

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

3.4 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Engineer.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 PAINT SCHEDULE:

A. METAL DOORS AND FRAMES:

Primer: B66W01310 - PI PROCRYL PR OF W
- Location: Metal Doors and Frames
Coat 1: B53W02151 - PI WB ALK UR SG EW
- Location: Metal Doors and Frames
Coat 2: B53W02151 - PI WB ALK UR SG EW
- Location: Metal Doors and Frames

B. CONCRETE / MASONRY SURFACES

Coat 1: B58W00610 - Macropoxy® 646 Fast Cure Epoxy Part A Mill White
- Location: Painted concrete floor
Notes: Must have A&B
Coat 2: B58W00610 - Macropoxy® 646 Fast Cure Epoxy Part A Mill White
- Location: Painted concrete floor
Notes: Must have A&B
Coat 3: B58W00610 - Macropoxy® 646 Fast Cure Epoxy Part A Mill White
- Location: Painted glazed masonry
Notes: Must have A&B

D. DRYWALL SURFACES:

Coat 1: B53W02151 - PI WB ALK UR SG EW
- Location: Existing Drywall and Plaster surfaces
Coat 2: B53W02151 - PI WB ALK UR SG EW
- Location: Existing Drywall and Plaster surfaces
Coat 3: B53W02151 - PI WB ALK UR SG EW
- Location: Existing Drywall and Plaster surfaces

E. WOOD / INTERIOR:
- Location: Existing Drywall and Plaster surfaces

Primer: B51W00620 - PrepRite® ProBlock® Interior/Exterior Latex Primer/Sealer White
Coat 1: B53W02151 - PI WB ALK UR SG EW
- Location: Existing Drywall and Plaster surfaces
Coat 2: B53W02151 - PI WB ALK UR SG EW
- Location: Existing Drywall and Plaster surfaces
Coat 1: S64T00050 - Sher-Wood® BAC Wiping Stain Clear Tint Base
- Location: Stained wood doors
Coat 2: 013205000 - Minwax® Indoor/Outdoor Helmsman® Spar Urethane Varnish Satin Clear
- Location: Stained wood doors

END OF SECTION 09900

SECTION 200500 – COMMON WORK REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of this Section shall apply to all Work for all Sections listed under Divisions 22, 23, and 26.
B. The Drawings show where ducts, raceways, equipment, fixtures, and accessories must be installed in order to harmonize with the building and installations of the various trades. Drawings shall be carefully checked during the course of bidding and construction. Drawing dimensions shall be used to determine exact locations and as a check with other contractors to avoid interferences with their work. Where component locations are not dimensioned, take necessary field measurements before installing work to insure fit and required clearances.
C. Refer to applicable drawings describing portions of the Work where other trades are involved on the Project so that added field work and delays resulting from conflicts are avoided. Components that are prefabricated before coordinating with the other trades will have to be refabricated at no additional cost if conflicts are encountered.

1.2 GENERAL REQUIREMENTS

A. The Contractor shall provide the labor, materials, equipment, accessories, and perform the operations in connection with the construction and installation of the work.
B. No outages, either full or partial, shall be permitted for any systems serving any portion of any existing building without prior written approval from the Owner. Such systems include but are not limited to gas, water, electric, drainage, telephone, and fire alarm. Unintentional cutting or interruption of water lines, electric conduit, or similar service lines in the course of Work performed under this Section shall be immediately repaired at no additional cost.
C. Materials or labor obviously required to fully complete the Work and make it operational, or to meet manufacturer's recommendations, shall be included even though each item necessarily involved may not be specifically mentioned or shown. Such Work and materials shall be furnished and shall be of the same grade or quality as the related parts specified and shown.
D. Should there be a conflict between the plans and specifications, the greater quantity and better quality shall be provided.
E. Remove and reinstall ceiling pads and grid runners as necessary to install materials or equipment above existing ceilings. Upon completion of the work, the condition of all ceilings shall be equal in quality to their conditions prior to construction.
F. All systems, equipment, and components requiring programming and/or labeling shall be programmed and/or labeled using the Owner's final room number scheme. Any programming, identification, or labeling done utilizing room numbers matching the Construction Drawings instead of the Owner's final room numbers shall result in a requirement for the Contractor to reprogram and relabel. It shall be the Contractor's responsibility to verify the final room numbering scheme.
G. Installation of all electrical wiring and of all UL listed products shall comply with all applicable requirements of the National Electrical Code.
H. Do not make field modifications to manufactured units.

1.3 QUALITY ASSURANCE

A. Materials used in this Contract shall be those specified herein unless proposals for the use of alternate materials have been submitted and accepted in writing. Materials shall be strictly first grade of their kind

and shall be new and in first-class condition when installed. Damaged materials will be rejected and shall be replaced by new materials.

B. No materials or equipment may be installed which do not meet the approval of the authorities having jurisdiction.

C. All products having connections to electrical wiring at any voltage shall be UL listed and labeled.

D. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code – Steel."

E. Qualify welding and brazing processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1.4 PROJECT CONDITIONS

A. Certain areas will be designated for the storage of materials and equipment. Cooperation with the Owner in minimizing interference with the Owner's operations is mandatory.

1. Store materials inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
2. Follow manufacturer's instructions for receiving, inspecting, handling, storage, and protection of products prior to installation.

B. Equipment Clearances and Requirements:

1. For many items of equipment described in these Specifications, several manufacturers are listed. Unless otherwise indicated, the first named in each instance is the Basis of Design manufacturer on which the layout was based and on which clearances, services required for electrical, mechanical, and plumbing characteristics have been shown. Additional manufacturers listed are considered acceptable.
2. Due to the possibility of restrictions imposed by space limitations, the responsibility for resolving conflicts resulting from the use of equipment other than Basis of Design shall rest with the Contractor furnishing the equipment. Submission of other named manufacturer's equipment for approval shall be considered as a certification that clearances for access, service, maintenance, and utilities connections have been checked by the Contractor and found adequate.
3. Alternate equipment or the equipment of other acceptable manufacturers named in these documents shall meet all Specifications. If any equipment which the bidder proposes to furnish, deviates from the Basis of Design product regarding dimensions, weight, electric service, power wiring, control wiring, plumbing, piping, sound generation, vibration, or any other property, it shall be the responsibility of the contractor to pay all additional costs or charges resulting from use of the alternate equipment.

C. Ductwork, raceways, systems, and equipment shall be offset, lowered or raised, as required, or as directed at the site if necessary to accommodate field conditions, but only after receiving written authorization from the Engineer to do so.

1.5 SUBSTITUTES

A. Where equipment, fixtures, or materials are specified by brand and model, substitutes will be approved only if every component of the proposed substitute meets or exceeds the quality of the components of the specified equipment, fixtures, or materials.

B. Equipment pads, connections, capacities of inter-related equipment, etc. have been designed based on specific brands and models named. Where substitutes are approved the contractor shall bear the cost of any and all changes made necessary by the use of such substitute equipment.

C. Equipment, fixtures, and materials named by brand and model are named in the interest of obtaining complete, integrated working systems. Substitutes will be considered as required to avoid limiting competition.

D. The naming of products and materials incorporates the printed specifications and drawings of the manufacturer's products listed and these shall be considered a part of the specifications as though repeated therein.

1.6 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions and in Division 1. Where these sections do not define the following terms, the definition given below applies.

1. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, and to paragraphs or schedules in the Specifications, and to similar requirements anywhere in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference.
2. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Engineer, requested by the Engineer, and similar phrases.
3. Approved: The term approved, when used in conjunction, with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.
4. Regulation: The term regulation includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that are indicated to control performance of the Work.
5. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and other similar operations.
6. Install: The term install describes operations at the Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
7. Provide: The term provide means to furnish and install, complete and ready for the intended use.
8. Installer: An Installer is the Contractor or any entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
    a. The term experienced, when used with the term Installer means having completed work on a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
    b. Trades: Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
9. Project Site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS AND ACCESSORIES

A. Motors, controllers, and disconnect switches furnished as part of any equipment shall be UL Listed and shall have the voltage and electrical characteristics of the service indicated or as required.

B. All motors shall be premium efficiency type.
C. General Motor Requirements:

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Comply with IEEE 841 for severe-duty motors, where indicated.

D. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg. C. and at altitude of 3300 feet above sea level.
2. 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 at indicated service factor.

E. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Energy Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15, unless otherwise indicated.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating.
7. Insulation: Class F, unless otherwise indicated.
8. Code Letter Designation:
   a. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic, unless otherwise indicated.
9. Enclosure Material: Cast iron for motor frame sizes 324T and larger: rolled steel for motor frame sizes smaller than 324 T.
10. 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.

2.2 ESCUTCHEONS AND PLATES

A. Provide approved plates around each pipe or electrical conduit passing through walls, floors, partitions, and ceilings where the penetration is exposed to view. Plates shall be chrome-plated metal unless otherwise indicated and shall be sized to cover exposed ends of pipe insulation, pipe sleeves, and sealant.
B. Floor plates shall be split-type, heavy chrome-plated and securely attached to the pipe or conduit.

PART 3 - EXECUTION

3.1 SUPERVISION AND COORDINATION

A. Do not install anything except electrical raceways in NEC required clear space above any electrical panelboards, switchgear, or transformers.
B. No materials shall be installed in locations indicated to be occupied by other materials, equipment, fixtures or systems.

3.2 INSTALLATION

A. Motors, Starters, Controls, and Wiring

1. Alignment of motors, that are factory coupled and mounted or field coupled and mounted, shall be checked after installation is complete and again after 48 hours of operation in design service.
2. Controllers, disconnects, controls, and wiring shall be coordinated with the appropriate Contractors.

B. Cutting and Patching

1. Finished patched surfaces shall match adjacent surrounding surfaces. Tooth masonry. Provide lintels over all new openings in existing walls as indicated on structural drawings and in structural specifications.
2. Cutting and drilling of walls, slabs, and decks, shall be neatly done, removing no unnecessary material. Holes and openings, shall be located where they will not weaken the structure. No structural member shall be cut.
3. Cutting of round holes in masonry and concrete shall be performed with a core drill to minimize spalling, and limit damage to the structure. Locations shall be accurately determined and checked, and the appropriate drill bit shall be used to minimize hole size. Reinforcing steel bars shall be located prior to drilling and shall not be cut.
4. Escutcheons and trim plates shall be provided. Size openings for penetrations such that installation shall permit free movement of the penetrating item.
5. Where any existing items are removed, patch all resulting openings and all resulting exposed surfaces in floors, walls or ceilings. Patching shall be done by an experienced mechanic of the appropriate trade.
6. All roof patching shall be accomplished by a roofing system manufacturer approved roofing contractor. The Contractor shall be responsible for contacting the original roofing system manufacturer for instructions and for insuring that no existing roof guarantees are voided by the methods of performing the work.

C. Penetration Sleeves: Install penetration sleeves where raceways or piping pass through walls, floors, ceilings, or roofs.
1. Pipe insulation shall be continuous through pipe penetrations unless otherwise indicated.
2. Flash and seal all penetrations of roofs and exterior walls.

D. Protection

1. Provide protection to the building during the execution of all Work.
2. This protection shall include covering apparatus, building surfaces, and other materials to protect them from dirt; adequate temporary connections to protect apparatus from damage and required shielding to protect finished parts of the building. The following shall apply where applicable:
    a. Protect finished floors from chips and cutting oil by the use of metal chip receiving pans and oilproof floor covers.
    b. Protect equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets.
    c. Protect equipment and finished surfaces from paint droppings, insulation adhesive, sizing droppings, etc., by use of drop cloths.
3. Pumps, motors, fans, and other stored equipment shall be adequately protected with openings, bearings, etc., covered to exclude dust and moisture. Stockpiled pipe, conduit, valves, fittings, ductwork, etc., shall be placed on dunnage and protected from weather and from entry of foreign material.
4. During installation and until final connections are made, piping, raceways, and ductwork shall be protected against entry of foreign matter by keeping all open ends capped, plugged, or covered. Equipment connections shall be kept sealed until the time of system tie-in.

E. Accessibility

1. All plumbing, mechanical, and electrical connections to equipment shall be installed in a manner to facilitate inspection, maintenance, and repair of the equipment and its components.
2. Install suspended equipment to provide the maximum possible headroom, where mounting heights are not indicated.
3. Install equipment level and plumb, parallel and perpendicular to other building systems and components, except where otherwise indicated.
4. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

F. Erection of Metal Supports and Anchorage

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment.
2. Field Welding: Comply with AWS D1.1 "Structural Welding Code – Steel."

G. Suspended Construction

1. Locate roof penetrations to avoid joists, beams, and trusses.
2. Provide 3 x 3 x 1/4 inch minimum steel angle or equal strength members between joists, beams, and trusses where hanger rods occur between members. Provide beam clamps or other approved means of attachment for attaching hanger rods and supplemental steel cross supports to joists, beams, and trusses. Supports and attachments shall be sized to limit deflection to L/240 for loads they are intended to support. Welding of supports or attachments to steel joists or trusses shall not be permitted.
3. All hangers that are supported from steel joists or trusses shall be attached to the top or bottom chord of steel joists or trusses within 2 inches of a panel point wherever possible. All hanger attachments not within 2 inches of a panel point that support more than 100 pounds weight shall have web reinforcing installed Web reinforcement shall be installed before concentrated loads are applied.
4. For steel joists, in addition to the above requirements, connections for suspended items shall not violate any requirements or recommendations contained in the Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Girders document published by the Steel Joist Institute.
5. No direct connection to metal deck is permitted.
6. Where suspended supports are necessary to be placed at locations other than indicated above, provide supplemental steel spanning between bearing wall, beams, and/or girders. Supplemental steel shall be sized to limit deflection to less than L/240 of the member's length when full load is applied.

H. Selective Demolition

1. Disconnect, demolish, and remove existing construction as indicated.
2. Where pipe, ductwork, insulation, raceways, cable, cable tray equipment, or other components to remain are damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
3. Remove indicated exposed pipe, ductwork, wiring, and accessories in their entirety.
4. Abandoned Work: Cut and remove buried or concealed pipe or raceways indicated to be abandoned in place, beneath the face of adjacent construction to remain. Cap pipe or raceways openings and patch surfaces to match existing finish.
5. Unless otherwise indicated, removed items shall be the removing contractor's property and shall be locally disposed of off site.
6. Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation or reinstallation.

7. Where fixtures, devices, or equipment are removed, remove all connected piping and raceways to 1 inch beyond the exposed surface of the floor below, the floor/ceiling structure above or the first wall to remain.
8. Where items having wiring connections are removed, remove all conductors that no longer serve any remaining loads.
9. Prior to project completion, trace all existing circuits that remain and provide new panelboard directories in all existing panelboards that have been modified as part of the work.
10. Where piping or raceways are removed, cap or plug the particular type of pipe or raceway existing at each application. End plugs and caps shall be provided and installed such that they are not visible in walls, floors or ceilings in finished areas.
11. Do not damage walls, ceilings or structure to remain in areas to receive selective demolition.
12. Patch all openings in walls, floors, ceilings and roofs created by removals.
13. All items shown on Demolition Plans are existing and shall remain in place unless otherwise indicated. Protect all items to remain from damage.
14. Openings created by selective demolition shall be framed. Openings in steel framed construction shall be framed with 3 x 3 x 1/4 inch angle unless otherwise indicated. Frame materials shall be connected to existing framing in accordance with structural specifications and applicable industry standards.
15. All roofing work, including roof patching, shall be accomplished by a contractor approved by the roofing manufacturer.
16. Unless otherwise indicated, where ceilings must be removed in order to install equipment or materials, reinstall the ceiling at completion of construction. The reinstalled condition of the ceiling shall be equal in quality and appearance to its preconstruction condition.
17. Where devices are removed and device box remains, provide stainless steel device plate on existing device box.

3.3 FINAL COMPLETION

A. Work shall be cleaned prior to Substantial Completion of the Work.
B. Retouch or repaint factory painted prime and finish coats where scratched or damaged.
C. Deliver all specified spare parts to Owner and obtain signed receipts of delivery.
D. The Contractor shall clean equipment; restore damaged materials, remove grease, oil, chemical, paint spots, and stains, and leave the Work in condition acceptable to owner.
E. The Contractor shall remove from the site tools, equipment, surplus materials, and rubbish pertaining to his operations.

END OF SECTION 200500

SECTION 200700 –DUCT INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.2 QUALITY ASSURANCE

A. 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, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
B. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II with factory applied ASJ.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Owens Corning; All-Service Duct Wrap.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

2.4 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.6 SECUREMENTS

A. 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.
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.
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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. 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. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    c. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum or stainless-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. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL 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 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.

C. Install insulation with longitudinal seams at top and bottom of horizontal runs.
D. Keep insulation materials dry during application and finishing.
E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
F. Install insulation with least number of joints practical.
G. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, and other projections with vapor-barrier mastic.
H. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
I. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
L. 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.

3.3 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and 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.
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, pins are not required. 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.

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.

3.4 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.

B. Items Not Insulated:

1. Metal ducts with duct liner.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Factory-insulated access panels and doors.

3.5 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. All, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 200700

SECTION 221122 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping, Valves, and Regulators: 100 psig minimum unless otherwise indicated.

1.2 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.

B. Field quality-control reports.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
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.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements of NFPA 54.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.
d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

2.2 PIPING SPECIALTIES

A. 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.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Actaris.
b. American Meter Company.
c. Eclipse Combustion, Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 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 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.

3.2 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install fittings for changes in direction and branch connections.

C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping at right angles or parallel to building walls.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Locate valves for easy access.
F. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with UL Listed Through-Penetration Firestop Assemblies.
J. Verify final equipment locations for roughing-in.
K. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
L. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
M. Conceal pipe installations above ceilings unless indicated to be exposed to view.
N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
O. Connect branch piping from top or side of horizontal piping.
P. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance.
B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

3.6 HANGER AND SUPPORT INSTALLATION

A. 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.

3.7 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
B. Install piping adjacent to appliances to allow service and maintenance of appliances.
C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 PAINTING

A. Paint exposed piping, valves, and piping specialties.

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: Yellow.

B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

B. Submit test and inspection reports.

3.10 PIPING SCHEDULE

A. Aboveground, branch piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

END OF SECTION 221122

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DEFINITIONS

A. AABC: Associated Air Balance Council.
B. NEBB: National Environmental Balancing Bureau.
C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, adjusting and Balancing Bureau.

1.2 SUBMITTALS

A. Certified TAB reports.
B. Sample report forms.
C. Instrument calibration reports.

1.3 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.4 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before TAB is completed. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
B. Examine systems for installed balancing devices.

C. Examine the approved submittals for HVAC systems and equipment.
D. Examine equipment performance data.
E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
F. Examine test reports specified in individual system and equipment Sections.
G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
H. Examine operating safety interlocks and controls on HVAC equipment.
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. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are complete and fully operational.
3. Equipment and duct access doors are securely closed.
4. Balance 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 on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's "HVAC Systems – Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to insulation specifications.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
D. 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. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
C. Verify that motor starters are equipped with properly sized thermal protection.

D. Check dampers for proper position to achieve desired airflow path.
E. Check for airflow blockages.
F. Check condensate drains for proper connections and functioning.
G. Verify that air duct system is sealed as specified.

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 total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the 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.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

C. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

3.6 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.
B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
C. Record controller settings and note variances between set points and actual measurements.
D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
E. Check free travel and proper operation of control devices such as damper and valve operators.
F. Check the sequence of operation of control devices.
G. Check the interaction of interlock and lockout systems.
H. Note operation of electric actuators using spring return for proper fail-safe operations.
I. TAB Report shall address each temperature control verification item.

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. 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.
11. Notes to explain why certain final data in the body of reports vary from indicated values.
12. Test conditions for fans performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.

C. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.

b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Outdoor airflow in cfm.
f. Return airflow in cfm.
g. Outdoor-air damper position.
h. Return-air damper position.

D. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 230593

SECTION 230900 – INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high-speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with colorgraphic displays. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet.

B. The system shall consist of an architecture that utilizes a MS/TP selectable 9.6-76.8 K9600 Baud protocol, as the common communication protocol between all controllers and integral ANSI/ASHRAE Standard 135-2004, BACnet functionality to assure interoperability between all system components.

C. Complete temperature control system to be DDC with electronic sensors and electronic actuation of valves and dampers specified herein.

D. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work.

E. All materials and equipment used shall be standard components, regularly manufactured for the specified system.

F. Control system network shall be designed to allow web-based monitoring and control of all scheduling, alarm management, trending and operational setpoints.

G. Contractor shall be responsible for:

1. Providing extension of existing DDC electronic automatic temperature control system.
2. Providing of control devices, valves, instruments, and the like, as herein specified and as required to comply with required sequences of automatic control.
3. Providing of wiring for secondary control devices, relay switches, safety low limit controls, etc., and such interlock wiring required.
4. Provide all necessary transformers for low voltage control wiring requirements.
5. Testing of system.

1.2 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product to be incorporated into the work.

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. Schematic flow diagrams.
2. Wiring Diagrams.
3. Written description of sequence of operation.
4. Schedule of dampers including size, leakage, and flow characteristics.
5. Listing of connected data points, including connected control unit and input device.
6. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
7. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.3 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 90A, "Installation of Air Conditioning and Ventilation Systems."
C. Comply with National Electric Code, UL-916 Energy Management Systems, UL, FCC Part 15, subpart J, Class B Computing Devices.
D. Comply with ANSI/ASHRAE Standard 135-2004.

1.4 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

1.5 WARRANTY AND MAINTENANCE

A. All components, system software, and parts furnished and installed by the contractor shall be guaranteed against defects in materials and workmanship for one year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the contractor at no charge during normal working hours during the warranty period. Response times to warranty claims shall be a maximum of 48 hours. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide systems, equipment, and installation by one of the following:

    1. Automated Logic

2.2 DDC EQUIPMENT

A. Control Units General: Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate controller for each rooftop heat pump unit. Each of the following panel types shall meet the following requirements.

    1. Controllers shall be suitable for the anticipated ambient conditions.

        a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at (-40 deg. C to 60 deg. C) (-40 deg. F to 140 deg. F) and 5 to 95% RH, non-condensing.
        b. Controllers used in conditioned ambient space shall be mounted in dust-proof enclosures and shall be rated for operation at (o deg. C to 50 deg. C) (32 deg. F to 122 deg. F) and 5 to 95% RH, non-condensing.

2. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

2.3 SENSORS

A. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum, thermistor, or balco.

a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5-year drift of no more than .225°F maximum error of no more than .36°F.
b. Wire: Twisted, shielded-pair cable.
c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 9.4 sq. ft.
d. Averaging Elements in Ducts: 60 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; length as required.
e.
f. Room Sensors:

1) Basic user functions (LCD, internal temperature analog to digital conversion, setpoint adjustment, and tenant override)
2) Color: Neutral.
3) Orientation: Vertical or horizontal.

g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

2. Humidity Sensors: Bulk polymer sensor element.
a. Accuracy: 5 percent full range with linear output.
b. Room Sensors: Range of 0 to 100 percent relative humidity.
c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

2.4 VALVE AND DAMPER OPERATORS

A. Damper Operators

1. Damper operators shall be electronic, spring return, low voltage (24 VAC), and shall be properly sized to stroke the damper smoothly and efficiently throughout its range. Actuator response shall be linear in response to sensed load.
a. Damper operators on outside air intakes/exhaust shall be spring return closed. Damper operators on return dampers shall be spring return open.

2. Operators shall be rated for not less than 180 inch-pounds torque. Provide not less than one damper operator for each 20 square feet of damper area.
3. All damper operators shall be warranted for 5 years from date of manufacturing.

2.5 DAMPERS

A. Dampers intended for automatic control, unless part of a factory-made unit, shall be furnished by the contractor. Automatic dampers installed in unitary equipment furnished by the manufacturer shall be checked for proper size and design by the Contractor. Should any features of these dampers appear to be unsatisfactory, full details shall be given to the Engineer, in writing, and suggestions made for necessary corrections.

B. Return Air Dampers

1. Return air dampers, unless otherwise specified, shall be “low leakage” dampers, and shall be designed for tight shut-off such that for a 1500 FPM damper, leakage does not exceed 1.7 CFM at 1 inch W.G. differential static pressure.
2. Damper frame shall be 4” deep constructed of extruded aluminum not less than .080 inches thick.
3. Damper blades shall be constructed of extruded aluminum and airfoil design. Aluminum end caps shall be press fitted to the blade ends.
4. Silent closing replaceable silicone seals shall be provided on each blade and on all four sides of the frame. Louver linkage to be concealed in frame channel outside of the air stream. Bearings shall be constructed of a celcon inner bearing fixed to a 7/16’ aluminum hexagon type blade pin rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal contact or metal to plastic contact.
5. Blade and frame seals shall be secured in an integral slot within the aluminum extrusions.
6. Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion resistant, zinc-plated steel, complete with sup-point trunnion screws for a slip-proof grip.
7. Modulating dampers shall be opposed blade type.
8. Dampers shall be designed to operate in temperature ranges from -40 degrees F. and 212 degrees F.
9. Manufacturers: Tamco, Ruskin or Greenheck.

C. Outside Air and Relief Air Dampers

1. Automatic dampers used for outside air and relief air applications shall have similar type of construction as described above for return air dampers, but shall include extruded aluminum blade shell internally insulated with expanded polyurethane foam and thermally broken.
2. Damper frame shall be extruded aluminum, minimum 4” deep and insulated with Styrofoam on all four sides of the damper.
3. Blade and frame seals shall be extruded silicone and secured in an integral slot within the aluminum extrusions.
4. Dampers shall not exceed 4 cfm per sq. ft. against 4” w.g. and shall be AMCA Rated.
5. Standard control dampers are not acceptable in outside air and relief air applications to avoid possible freeze conditions.
6. Manufacturers: Tamco, Ruskin or Greenheck.

2.6 RELAYS

A. Electric

1. Where required, provide relays for energizing or re-energizing the various branch circuits, in response to master control panels. Relays shall be UL Labeled and sized for not less than 140 percent of the connected amperage load. Relays shall be rated for the system voltage and have proper throw and poles. Relays shall have Hand-Off-Auto switches available on board for manually overriding all DDC digital output points.

2.7 TRANSFORMERS AND POWER SUPPLIES

A. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
B. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 70.0 mV maximum Peak-to-Peak. Regulation shall be 5% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
C. Unit shall be UL recognized.

2.18 TEMPERATURE CONTROL WIRING

A. Wiring above accessible lay-in ceilings shall be open wired UL listed plenum cable or shall be installed in conduit.
B. Conduit shall be 3/4 inch minimum size. All conduit for low voltage wiring shall be as specified for electrical power wiring.
C. Concealed wiring and wiring above accessible lay-in ceilings, which is operating under 100 volts, may be open wired if in compliance with Article 725, NFPA-70 (NEC). Open wiring shall be secured with plastic tie wraps to the permanent building structure.
D. Wire and conduit not indicated on the drawings or in the specifications, but required by the controls supplier, shall be provided by the Contractor.
E. Communication cable shall be a minimum of category 6, installed per manufacturer's guidelines concerning isolation and separation from other wiring and control cabling.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment level and plumb.
B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
C. Connect and configure equipment and software to achieve sequence of operation specified.
D. Verify location of sensor, humidistats, carbon dioxide sensors, and other exposed control sensors with Owner.
E. Install damper actuators on outside of duct in warm areas.
F. Installation of Pathways

1. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
2. Install manufactured conduit sweeps and long-radius elbows whenever possible.

G. Installation of Cables

1. Comply with NECA 1.
2. General Requirements for Cabling:

a. Comply with TIA/EIA-568-B.1.
b. Terminate conductors; no cable shall contain unterminated elements.
c. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches.
d. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

3. Open-Cable Installation:

a. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

4. Separation from EMI Sources:

a. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper cable from potential EMI sources, including electrical power lines and equipment.

b. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties.

B. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify local control units including self-diagnostics.

C. The Contractor shall cycle all dampers and confirm all sensors and controls are complete and functioning.

3.3 COMPLETION

A. When the work is completed, and at a time directed by the Owner, the Contractor shall carefully adjust all parts of the equipment and systems. This includes adjustment of automatic controls and safety devices, proper setting of adjustable devices, dampers and valves, and other necessary operations so the systems are fully operable and automatic in operation. Upon completion of the work, notify the Owner that system is ready for final tests and inspection.

B. At the time of final inspection, this Contractor shall be represented by a person with the proper authority, who shall demonstrate that his work fully complies with the purpose and intent of the Specifications and Drawings. Labor, services, instruments, and tools necessary for demonstrations and tests shall be provided by the Contractor.

C. The Contractor shall test and adjust each instrument specialty and equipment furnished by him, prior to final acceptance. The Contractor shall demonstrate, for approval, that subsystems operate as a coordinated and properly functioning, integrated system.

D. The Contractor shall furnish labor and materials and provide adjustments necessary to obtain the desired and intended results.

3.4 GRAPHIC PACKAGE

A. Dynamic Animated Data Displays

1. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention. Damper positions shall be animated and shall represent actual, current conditions.

END OF SECTION 230900

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and specified seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.2 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:
1. Factory- and shop-fabricated ducts and fittings.
2. Reinforcement and spacing.
3. Seam and joint construction.
4. Equipment connections.
5. Hangers and supports, including methods for duct and building attachment.

1.3 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: 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: Comply with ASTM A 653/A 653M.

    1. Galvanized Coating Designation: G90.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard.

        a. Maximum Thermal Conductivity:

            1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

    2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
    3. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

        a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. 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.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

2.5 SEALANT 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. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. 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.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. 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."
C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
B. Install ducts with fewest possible joints.
C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
B. Hanger Spacing: 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," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors.
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 CLEANING NEW HVAC SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
B. Use service openings, as required, for physical and mechanical entry and for inspection. Ducts may be cleaned as they are being installed.
C. Clean the following metal duct systems by removing interior surface contaminants and deposits:

    1. Air outlets and inlets (registers, grilles, and diffusers).
    2. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, and filter sections.
    3. Coils and related components.
    4. Return-air ducts.
    5. Supply-air ducts.

D. Mechanical Cleaning Methodology:

    1. Clean metal duct systems to extract contaminants from within duct systems and remove contaminants from building.
    2. Clean fibrous-glass duct liner with vacuuming equipment; do not permit duct liner to get wet.
    3. Clean coils and coil drain pans. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

E. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants and submit report where cleaning is completed.

3.6 DUCT SCHEDULE

A. Fabricate interior ducts with galvanized sheet steel.
B. All Ducts:

1. Pressure Class: Positive 2-inch wg.
2. Minimum SMACNA Seal Class: C.
3. SMACNA Leakage Class for Rectangular: 24.
4. SMACNA Leakage Class for Round: 12.

C. Liner:

1. Supply Air Ducts: Fibrous glass, 1 inch thick.
2. Return Air Ducts: Fibrous glass, 1 inch thick.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of product indicated.

1.2 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 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: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:

a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch thick.

5. Blade Axles: Nonferrous metal.

6. Bearings:

    a. Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

2.3 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
C. Vane Construction: Single wall.

2.4 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.
B. Coatings and Adhesives: Comply with UL 181, Class 1.
C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

    1. Minimum Weight: 26 oz./sq. yd..
    2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
    3. Service Temperature: Minus 40 to plus 200 deg F.

2.5 FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; 1 1/2” thick fibrous-glass insulation; polyethylene vapor-barrier film.

    1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
    2. Maximum Air Velocity: 4000 fpm.
    3. Temperature Range: Minus 20 to plus 175 deg F.
    4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.

B. Flexible Duct Connectors:

    1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or nylon strap in sizes 3 through 18 inches, to suit duct size.

2.6 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
B. Install volume dampers where indicated. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

    1. Install steel volume dampers in steel ducts.

C. Set dampers to fully open position before testing, adjusting, and balancing.
D. Install test holes at fan inlets and outlets and elsewhere as indicated.
E. Install flexible connectors to connect ducts to equipment.
F. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
G. Connect flexible ducts to metal ducts with draw bands.
H. Seal flexible duct outer covering to adjoining surfaces by applying vapor barrier tape or sealant at all flexible duct terminations.
I. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

    1. Operate dampers to verify full range of movement.
    2. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Ceiling Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Titus.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Nailor Industries Inc.
    e. Price Industries.

2. General: Except as otherwise indicated, provide manufacturer's standard ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
3. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support.

2.2 REGISTERS AND GRILLES

A. Registers and Grilles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Titus.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Nailor Industries Inc.
    e. Price Industries.

2. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

3. Wall and Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into construction with accurate fit and adequate support.

2.3 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."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.
B. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, seismic loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

1.2 SUBMITTALS

A. Product Data: For each type of product specified.

1.3 COORDINATION

A. Coordinate installation of roof curbs and roof penetrations.
B. Coordinate the size and location of structural steel support members.

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 ROOF HOODS

A. Manufacturers:

1. Acme Engineering & Mfg. Corp.
2. Aerovent; a Twin City Fan company.
3. Carnes.
4. Greenheck.
5. JencoFan.
6. Loren Cook Company.
7. Penn Ventilation.

B. Factory fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
D. Insulation: 1 inch thick fiberglass insulation to prevent condensation.

E. Roof Curbs: Prefabricated galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: To suit type of roofing system and match pitch of roof with mounting surface level.
2. Overall Height: 18 inches.

F. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.
G. Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install relief ventilators level, plumb, and at indicated alignment with adjacent work.
B. Secure relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.
C. Install relief ventilators with clearances for service and maintenance.
D. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work.

END OF SECTION 233723

SECTION 237415 – PACKAGED ROOFTOP HVAC UNITS, 3 TO 10 TONS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, wiring diagrams, and furnished specialties and accessories for each Rooftop HVAC Unit (RTU) type and configuration.
B. Warranty: Special warranty specified in this Section.

1.2 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
E. UL Compliance: Comply with UL 1995.

1.3 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
1. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than ten years from date of Substantial Completion.
3. Warranty Period for Solid-state Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish 1 spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane
2. AAON, Inc.
3. Carrier Corporation.
4. McQuay International.
5. Valent
6. YORK International Corporation.

2.2 Casing:

A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
B. Casing Material: Galvanized steel with factory-painted finished, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1 inch.
   3. Liner Adhesive: Comply with ASTM C 916, Type I.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with ASHRAE 62.1-2004.
   1. Drain Connections: Threaded nipple.

E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.3 COILS

A. Test and rate unit according to ASHRAE 33.
B. Indoor Air Refrigerant Coils: Mechanically bonded aluminum fins spaced no closer than 0.1 inch. Comply with ARI 210/240, and leak test to minimum 300 psig for a minimum 200-psig working pressure.
C. Outdoor Air Refrigerant Coils: Mechanically bonded aluminum fins spaced no closer than 0.1 inch. Comply with ARI 210/240, and leak test to minimum 300 psig for a minimum 200-psig working pressure for all aluminum coils.

2.4 FANS

A. Supply-Air Fans: Double width, backward inclined, centrifugal; with permanently lubricated, motor. Aluminum or painted-steel wheels, and galvanized-or painted-steel fan scrolls.
B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: As required for multi-stage or variance capacity.
B. Compressor: Hermetic, scroll, multi-stage or variable capacity mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.
C. Refrigeration Specialties:
   1. Refrigerant: R-407C or R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
   9. Provide hot gas reheat for dehumidification.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated; Minimum 90 percent arrestance, and MERV 8.

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger: Stainless steel.
D. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve with vertical extension.
E. Safety Controls:
   1. Gas Control Valve: Modulating.
   2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade, low-leakage, galvanized-steel dampers mechanically fastened to casing and having galvanized-steel operating rods. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Dampers shall have blade and edge seals.

2.9 ELECTRICAL POWER CONNECTION

A. Provide through-the-base single connection of power to unit with unit-mounted circuit breaker accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
B. Provide powered 120-volt duplex receptacle with service disconnect.

2.10 CONTROLS

A. Basic Unit Controls:
   1. Control-voltage transformer.
   2. Wall-mounted thermostat or temperature controller with the following features:
      a. Heat-cool-off switch.
      b. Fan on-auto switch.
      c. Automatic changeover.
      d. Adjustable deadband.
      e. Accessible set point adjustment mechanism.
      f. Visible temperature indication in degrees
      g. Unoccupied-period-override push button.
   3. Wall-mounted humidistat or humidity controller with the following features:
      a. Adjustable deadband.
      b. Accessible set point adjustment mechanism.
      c. Visible humidity indication in percent relative humidity.
      d. Humidity sensed above setpoint shall initiate operation of the dehumidification mode, which shall utilize hot gas reheat to maintain room temperature.
   4. Economizer controller with the following features:
      a. Outdoor temperature sensor
      b. Outdoor humidity sensor.
      c. Comparator to compare enthalpy of outdoor and return air.
      d. Controller shall modulate outdoor and return air dampers to exceed the minimum ventilation air setpoint or the demand ventilation controller whenever increased outdoor air intake can be utilized to reduce compressor operation for cooling.
      e. Economizer operation shall be based on enthalpy comparison.
   5. BACnet communications interface.
      a. Interface shall be connected to the BAS system to monitor all items required by the Sequence of Controls specification.
      b. Interface shall be utilized for all control input functions addressed above, and the room temperature and humidity sensors and controllers addressed above shall be provided as part of the BAS system instead of by the RTU manufacturer, and the sensor/controllers shall communicate to the RTU though the BAS system rather than by direct-wired connection to the RTU.

2.11 ACCESSORIES

A. Hail guards of galvanized steel, painted to match casing.
B. Rain hood, painted to match casing.
C. Clogged filter/fan failure switch.
D. Discharge air temperature sensor.

2.12 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, complying with NRCA standards.
B. Curb Height 12 inches minimum on short side.
C. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project Site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install RTU system and components to comply with NFPA 90A.

3.2 ROOF CURBS

A. Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
B. Install wind and seismic restraints according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Connect condensate drain pan using NPS 1", Type M copper tubing. Construct trap at connection to drain pan in accordance with manufacturer's recommendations.
B. Connect ducts to unit with flexible duct connectors.
C. Electrical Connections:
    1. Install and wire devices furnished with rooftop units but not specified to be factory mounted or wired.
    2. Wiring shall be installed in conduit.

D. Connect gas piping to the RTU.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:

    1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    2. Operate cooling system to verify proper operation of staging or variable capacity control.
    3. Operate gas heating through its full range to verify proper operation.
    4. Operate dehumidification cycle to verify proper operation.
    5. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 Startup Service:

1. Engage a factory-authorized service representative to perform startup service.
2. Complete installation and startup checks according to manufacturer’s written instructions.

3.6 Cleaning:

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 Demonstration:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 238229

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.
C. Conductor Insulation: Comply with NEMA WC 70 for Type THHN-THWN.
D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC use only where indicated.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded.
B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION, APPLICATIONS AND WIRING METHODS

A. Common Neutrals Prohibited: Every feeder and branch circuit that has a grounded conductor (a neutral conductor) shall have its own individual, dedicated grounded conductor throughout the length of the circuit. This grounded conductor shall terminate to the neutral bus in the panelboard or switchboard containing the circuit's overcurrent protective device and shall not be connected to the grounded conductor of any other circuit.

3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders: Type THHN-THWN, single conductors in raceway unless otherwise indicated.
B. Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway unless otherwise indicated.
C. Control Circuits: Type THHN-THWN, in raceway unless otherwise indicated.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, above ceilings, and under floor slabs, unless otherwise indicated.
B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall 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. Final routing and location of branch circuit raceways shall be determined by contractor.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections:

    1. After installing conductors and cables and before electrical circuitry has been energized, test conductors for continuity and insulation integrity.
    2. Perform visual and mechanical inspection and electrical tests as described in NETA Acceptance Testing Specification.

C. Test Reports: Prepare a written report.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.

2.2 CONNECTORS

A. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts. Clamp type, sized for pipe.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Copper.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Rated Strength: All components connecting to the structure shall be selected to be adequate in tension, shear, and pullout strength to resist maximum loads calculated or imposed, with a minimum structural safety factor of five times the applied force.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
    1. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
    2. 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.

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 where 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 support system, sized so loads can be increased by at least 25 percent in future without exceeding specified design load limits.

    1. Secure raceways and cables to supports.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry applied loads. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
4. To Cold Formed Steel: Sheet metal screws.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For surface raceways.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.
B. EMT: ANSI C80.3.
C. FMC: Zinc-coated steel.
D. LFMC: Flexible steel conduit with PVC jacket.
E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
F. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Walker Systems, Inc.; Wiremold Company (The).
b. Hubbell Incorporated
c. Mono-Systems, Inc.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid galvanized steel conduit.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed: Surface Metal Raceways unless otherwise indicated.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R, in damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.
D. Raceway Fittings: Compatible with raceways and suitable for use and location.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements except where requirements on Drawings or in this Article are stricter.
B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Where height of horizontal raceways is not specifically indicated, install as high as possible.
C. Complete raceway installation before starting conductor installation.
D. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
E. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
F. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
G. 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.
H. Raceways for Optical Fiber and Communications Cable: Install raceways as follows:

1. Install with a maximum of two 90-degree bends or equivalent for each length of raceway.

I. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed lighting fixtures, equipment subject to vibration or movement; and for motors.
J. Raceways shall be installed parallel with building lines.
K. The contractor shall be responsible for determining raceway sizes and quantities and for determining how conductors are to be grouped in raceways in accordance with NEC requirements where not indicated on drawings or in specifications.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

3.2 IDENTIFICATION SCHEDULE

A. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Provide labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 DEFINITIONS

A. LED: Light-emitting diode.
B. PIR: Passive infrared.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Delegated Design Submittal:
   1. Submit layout drawings showing dimensioned locations of all occupancy sensors and showing the coverage pattern of each sensor.
   2. The delegated design submittal shall bear a statement signed by an authorized employee of the sensor manufacturer certifying that the entire area of each room having occupancy sensors falls within the coverage pattern of the sensors as located on the submittal layout drawing.
   3. The quantity of sensors and their locations shown on the Construction Drawings are approximate and are dependent on the Contractor's selection of manufacturers and models of sensors.
   4. The delegated design submittal shall show complete coverage of all rooms having sensors. Provide more sensors than are shown on the Construction Drawings at no extra cost if required to achieve complete coverage of each room.

PART 2 - PRODUCTS

2.1 INDOOR LOW VOLTAGE SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Hubbell Lighting.
   2. Leviton Mfg. Company, Inc.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Novitas, Inc.
   5. TORK
   6. Watt Stopper (The).

B. General Description:

   1. Sensors shall be available with major motion coverage patterns of 500, 1000, and 2000 square feet. Furnish sensors in the quantities and sizes as indicated on the drawings.
   2. Sensor shall be available in ultrasonic frequency of 40 kHz or 32 kHz.
   3. Sensor shall have a microprocessor that automatically controls all adjustments for sensitivity and time to off settings. Sensor shall not require any manual adjustment during installation or operation. The sensor shall have self-adaptive adjustment feature as follows:
      a. Sensor shall adapt automatically to changing room conditions.
      b. Sensor microprocessor shall automatically adapt to a continuous airflow situation.
      c. Sensor's microprocessor shall monitor PIR background levels (for multi-technology sensors) and automatically make corresponding adjustments.

4. Sensor shall recognize any motion detected within 20 seconds of turning off the lighting as a false off. In response to a false off, the microprocessor shall increase the sensor sensitivity, and increase the time to off setting.
5. Sensor shall be capable of detecting a false on. The sensor shall decrease the sensitivity in response to the false on.
6. Sensor shall feature a time-out install test mode. The test mode shall automatically revert to standard time-out no longer than one hour after test mode is initiated.
7. The sensor shall retain all learned and adjusted settings in non-volatile memory during and after power loss.
8. Bypass and override control shall be located behind a cover to resist tampering. All controls shall be accessible from the front of the sensor. Controls shall be as follows:
    a. Sensor shall have manual controls and override switches to force manual adjustments. A control knob or switch shall be provided to:
        1) Select the timer setting between 30 seconds and 30 minutes.
        2) Set the initial settings for automatic sensitivity adjustments.
        3) Force on the lighting.
        4) Adjust sensitivity from 0% to 100%.
        5) Restore factory settings.
9. Sensor shall have real time LED motion indicators.
10. Field of view:
    a. 500 SF coverage sensors shall have a 180-degree coverage pattern.
    b. 1000 SF and 2000 SF coverage sensors shall have a 360-degree coverage pattern.
    c. Infrared lenses shall have a 360-degree field of view.
11. Sensor shall be furnished with an integral photocell. The photocell shall:
    a. Have an adjustable set point.
    b. Only prevent the lighting from coming on when the ambient light levels are above the set point.
12. Sensor housing shall be constructed of a high impact injection molded plastic and shall be off-white color.
13. Sensor shall have integral LED's visible on the face of the unit to indicate motion detection as follows:
    a. Green LED: Indicates ultrasonic motion detection.
    b. Red LED: Indicates passive infrared motion detection.
14. Sensor shall be provided with a variety of mask inserts for passive infrared rejection to prevent false tripping.
15. Power Requirements: 30-40mA at 24 VDC.
16. Sensor shall accept Class 2 wiring.

C. Ceiling Mounting Multi-Technology Sensors:

1. Sensor shall incorporate both Doppler shift ultrasonic and passive infrared motion detection technologies. Sensor shall not react to noise or ambient sound.
2. Sensor shall have two modes of operation:
    a. Multi-Technology Mode: Sensor shall utilize both ultrasonic and passive infra-red technologies. PIR shall be utilized to detect occupancy to turn lighting on and either technology shall be utilized to keep lighting on.
    b. Single-Technology Mode: Sensor shall utilize one technology as manually selected to control lighting, one technology be utilized to detect occupancy to turn on lighting and keep lighting on.

D. Ceiling Mount Ultrasonic Sensor:

1. Sensor shall utilize Doppler shift ultrasonic technology for motion detection technologies. Sensor shall not react to noise or ambient sound.

E. Ceiling Mount Passive Infra-Red Sensor:

1. Sensors shall be available with major motion coverage patterns of 450 and 1500 square feet. Furnish sensors in the quantities as indicated on the drawings.
2. Sensor shall utilize passive infrared technology for motion detection. Sensor shall not react to noise or ambient sound.

F. Power Switch Pack:

1. Unit shall be an integrated self-contained device consisting of an isolated load switching control relay and a transformer. Unit shall be suitable for switching of incandescent, magnetic low voltage, electronic low voltage, fluorescent and motor loads.
2. Power Pack shall be designed to mount through a 1/2" knock-out in a standard electrical enclosure and be constructed of a high impact, UL rated plastic.
3. Power Pack transformer shall provide full wave rectified and filtered 150mA minimum at 24 VDC output power.
4. Power Pack shall contain an integral multi-input power supply capable of accepting input voltage of either 120VAC or 277VAC.
5. The Power Switch Pack shall contain a high current relay for switching of lighting loads. The circuit shall be designed to switch respective load at the zero-crossing of the alternating current sine wave.
6. Relay contacts shall be silver alloy and shall have the following ratings:
   a. 20A for 120, 230 and 277 VAC Incandescent and Fluorescent Ballast.
   b. 1HP at 120VAC and 2HP at 240VAC Motor.
7. Power Pack shall have an integral isolated SPDT relay for integration with HVAC systems. The relay shall have one set of normally open and normally closed contacts rated for 0.5A at 125VAC and 1A at 30VDC.

2.2 SELF-CONTAINED SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Watt Stopper (The).
2. Hubbell Lighting.
3. Leviton Mfg. Company, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. TORK

B. General Description:

1. The sensor shall retain all learned and adjusted settings in non-volatile memory during and after power loss.
2. Sensor shall be programmable to operate in either automatic on/automatic off mode, or manual on/automatic off mode as follows:
   a. Automatic On/Automatic Off Mode: The push button shuts off the lighting, and places the unit in a temporary manual on mode. The unit will automatically revert to automatic on mode after no motion is detected for the time out period or push button is depressed a second time to turn on lighting.
   b. Manual On/Automatic Off Mode: The push button manually turns on the lighting. The unit will automatically turn off the lighting after no motion is detected for the time out period.
3. Sensor shall feature an ambient light level sensor that shall put the unit into manual on mode when the ambient light level is above the set point and shall revert to automatic on mode at low light level.
4. Sensor shall allow for the following manual adjustments:
   a. Fixed time out setting selectable from 30 seconds, 10 minutes, 20 minutes, and 30 minutes.

b. PIR detection range selectable from 30% to 100%.
c. Ultrasonic sensitivity selectable from low, medium and high settings.
d. Ambient light override adjustment.

5. Sensor shall have Walk-Through timing feature designed to minimize the amount of time the lights remain on when the room is only momentarily occupied.
6. Sensor housing shall be constructed of a high impact injection molded plastic with steel mounting plate.
7. Sensor shall incorporate a faceted Fresnel lens.
8. Sensor shall be white, ivory, almond, light almond or gray as selected by the Architect/Engineer.
9. Sensor shall have integral LED's visible on the face of the unit to indicate motion detection as follows:
   a. Green LED: Indicates ultrasonic motion detection.
   b. Red LED: Indicates passive infrared motion detection.
10. Sensor shall automatically adapt to the applied line voltage (120 or 277 VAC).
11. Sensor shall close the relay at AC sine wave zero crossing to protect the contacts.
12. Each wall box switch or sensor shall be provided with device plate.

C. Multi-Technology Wall Switch Sensor:

1. Sensor shall utilize both Doppler shift ultrasonic and passive infrared technology to detect motion. Sensor shall not react to noise or ambient sound.
2. Sensor's ultrasonic frequency shall be 50 kHz.
3. Sensor shall have a microprocessor that automatically controls all adjustments for sensitivity and time to off settings. Sensor shall adapt automatically to a continuous airflow situation.
4. Sensor shall have a microprocessor that automatically controls all adjustments for sensitivity and time to off settings. Sensor shall not require any manual adjustment. The sensor shall be able to have the adaptive feature disabled.
5. Field of View: 1200 square foot major motion coverage pattern (at 4 foot mounting height) with 180 degree coverage pattern.
6. Sensor shall incorporate adjustable blinders to allow for manual adjustment of the PIR coverage pattern.
7. Load Ratings: The sensor shall be capable of switching the following loads:
   a. Incandescent/Tungsten: 120VAC, 800W.
   b. Fluorescent: 120VAC, 1200VA; 277VAC, 2700VA.
   c. Motor: 120VAC, 1/4HP.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
B. Provide sensor in coverage pattern and size to cover indicated rooms.

3.2 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
B. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of panelboard, switching and 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. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail bus configuration, current, and voltage ratings.
3. Short-circuit current rating of panelboards and overcurrent protective devices.
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.2 QUALITY ASSURANCE

A. Comply with NEMA PB 1.
B. Comply with NFPA 70.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.4 PROJECT CONDITIONS

A. Environmental Limitations:

1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Conductor terminations shall be rated for minimum 75 degrees C applications.

D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt indicated symmetrical short-circuit current available at terminals.

2.2 BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1.
C. Mains: Circuit breaker or lugs only, as indicated.
D. Branch Overcurrent Protective Devices: Bolt on circuit breakers, replaceable without disturbing adjacent units.
E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with fully rated interrupting capacity to meet fault currents indicated for the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
B. Mount top of trim 72 inches above finished floor unless otherwise indicated.
C. Mount panelboard cabinet plumb and rigid without distortion of box.
D. Install overcurrent protective devices not already factory installed.
E. Install filler plates in unused spaces.
F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
G. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3.3 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

3.4 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 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of product indicated.

1.2 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.
B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.4 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
C. LED Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. 1000 Watt dimmers shall be derated to 80% when ganged with other devices.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.

2.6 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise indicated.
B. Coordination with Other Trades:

   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:

      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles, and on horizontally mounted receptacles in the same orientation throughout building.

F. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

3.2 IDENTIFICATION

A. Receptacles: Identify panelboard and circuit number from which served. Label inside of device plate.

3.3 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Comply with NEMA FU 1 for cartridge fuses.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littlefuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Feeders: Low Peak.
2. Branch Circuits: Low Peak.
3. Control Circuits: Class CC, Low Peak.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262813

SECTION 264313 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 DEFINITIONS

A. ATS: Acceptance Testing Specifications.
B. SVR: Suppressed voltage rating.
C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
C. Comply with NEMA LS 1.
D. Comply with UL 1283 and UL 1449.
E. Comply with NFPA 70.

1.4 PROJECT CONDITIONS

A. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

PART 2 - PRODUCTS

2.1 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Current Technology Inc.; Danaher Power Solutions.
3. LEA International.
4. Liebert Corporation; a division of Emerson Network Power.

5. Eaton Electrical Inc.: Cutler-Hammer Business Unit.
6. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
7. Siemens Energy & Automation, Inc.

B. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Surge Protection Device: IEEE C62.41-compliant, separate or integrally panelboard mounted, solid-state, parallel-connected, modular (with field-replaceable modules) or non-modular type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.

1. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
2. Fuses, rated at 200-kA interrupting capacity.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Four-digit transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

F. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1 unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide 30-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Tests and Inspections:

1. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of lighting fixture.

1.2 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. LED Fixtures: Comply with LM79 and LM80.
B. Metal Parts: Free of burrs and sharp corners and edges.
C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
D. 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.
E. 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.

2.3 LED LUMINAIRE COMPONENTS

A. LED Luminaire
1. LED luminaire shall be rated for ambient temperatures ranging from -35 degrees F to 105 degrees F.
2. LED luminaire shall be modular with provision for replacement of drivers, light engines, arrays, optics, reflectors, and other components without replacing entire luminaire.
3. The heat sink, light engine, and driver shall be accessible for maintenance.
4. The luminaire assembly shall be certified by Design Lights Consortium, Energy Star, Lighting Facts, or Lighting Design Lab.

B. LED Module
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Nichia
      b. Cree
      c. Achriche
      d. Phillips
      e. Osram/Sylvania
   2. LED Modules shall be rated for 50,000 hours of life at 70 percent output.
   3. LED Modules shall be tested in accordance with IESNA LM-79, LM-80, and TM-21.
   4. LED Modules shall be rated for minimum luminous efficacy of 80 lumens per watt.
   5. Color consistency shall comply with NEMA SSL-3.
   6. LED Modules shall have a minimum CRI of 70.

C. LED Driver
   1. The driver shall be rated for 50,000 hours life, have minimum efficiency of 85 percent at full load, and be UL 8750 labeled.
   2. Except where installed in wet locations, driver shall meet UL Class 2 requirements for dry or damp locations.
   3. The driver shall comply with FCC title 47 FCR Part 15, Class A requirements.
   4. The driver shall be UL 1449 listed for inherent short circuit protection, self-limited, overload protected.
   5. The driver shall have Class A sound rating.
   6. The driver shall be rated for 100 to 300 volt input with minimum power factor of 0.90.
   7. The driver shall have full dimming capability.

2.4 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
B. Internally Lighted Signs:

   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. 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. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
      g. Where emergency heads are indicated, each head shall provide 0.5 foot-candles on the floor at a distance of 20 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. Verify exact locations of fixtures not dimensioned and not obvious from reflected ceiling plan with Owner.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 265100

SECTION 283113 – EXTENSION OF EXISTING FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. Extension of existing fire alarm system.
B. All wiring shall be in raceways, meeting requirements of Division 26 – Electrical specifications for power wiring.

    1. The only exception is that wiring above accessible lay-in ceilings may be installed without raceway.

C. Wiring not in raceway shall be UL Listed plenum rated.
D. All wiring shall meet the recommendations of the system manufacturer.

1.2 SUBMITTALS

A. General Submittal Requirements:
    1. Shop Drawings shall be prepared by persons with the following qualifications:

        a. Trained and certified by manufacturer in fire-alarm system design.

B. Product Data: For each type of product indicated.
C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

    1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
    2. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: Provide shop drawings signed and sealed by a professional engineer registered in the state of the project. Certify that the extension of the existing system, as shown on the shop drawings, will meet all requirements of NFPA 72 and ADAAG.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as, an extension of existing system.
C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEMS OPERATIONAL DESCRIPTION

A. Match operation of existing system.
B. Provide additional batteries as required for completed system emergency power operation to meet NFPA 72 requirements.

2.2 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single or double action mechanism, to match existing.
2. Station Reset: Key- or wrench-operated switch.

2.3 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: General design shall match existing.
B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

    a. 110 cd.

2. MountingWall mounted unless otherwise indicated.
3. Flashing shall be in a temporal pattern, synchronized with other units.
4. Strobe Leads: Factory connected to screw terminals.
5. Mounting Faceplate: Factory finished, to match existing units.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.
B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.

2. Expand, modify, and supplement existing equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Audible Alarm-Indicating Devices: Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283113